WATER & SEWAGE WORKS

WATER SUPPLY • INDUSTRIAL WASTE TREATMENT • SEWAGE DISPOSAL

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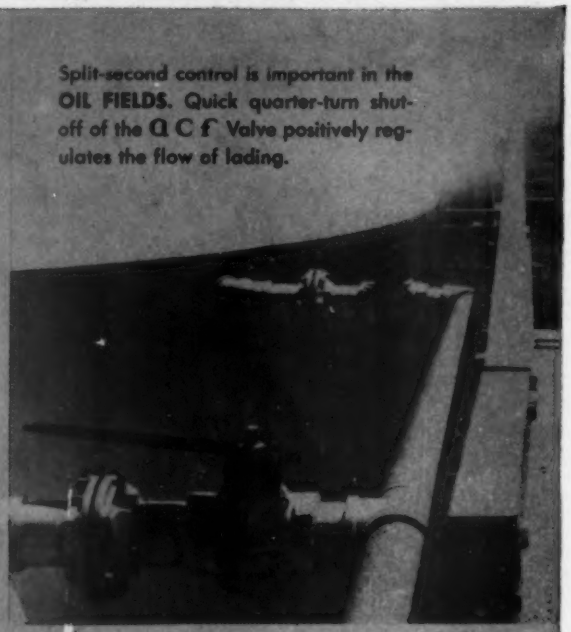
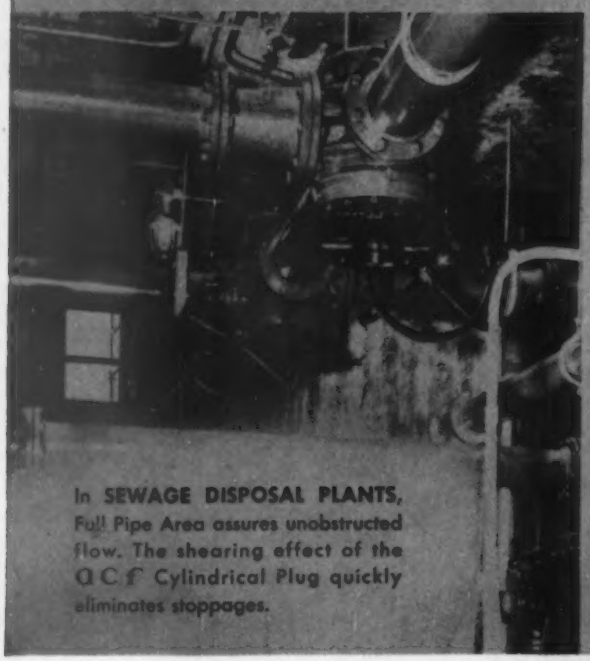
acf Cylindrical Plug Valves resist the abrasive effects of solids in suspension. This **CEMENT PLANT** installation has been in operation since 1949.



Split-second control is important in the **OIL FIELDS.** Quick quarter-turn shut-off of the acf Valve positively regulates the flow of lading.



In **SEWAGE DISPOSAL PLANTS,** Full Pipe Area assures unobstructed flow. The shearing effect of the acf Cylindrical Plug quickly eliminates stoppages.

acf Lubricated Plug Valves seal-in ladings such as at this **NATURAL GAS PLANT,** allow instant control with a minimum of maintenance.

acf

Representatives in 50 Principal Cities

CYLINDRICAL FULL PIPE AREA

PLUG VALVES

Write for descriptive Catalog 4-WS to ACF Industries, Incorporated, Valve Division, 1501 E. Ferry Avenue, Detroit 11, Michigan.

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Operates on Homelite Power

Here's the very newest in rock drills . . . a lightweight, ruggedly built tool that combines low initial cost with low operating costs. It's the BOSCH high cycle electric rock drill, complete with high pressure blower, imported from Germany and sold exclusively by Homelite. Drill weighs only 65 pounds yet matches the performance of bulky, expensive compressed air equipment. Both drill and blower operate on power from a lightweight, carryable Homelite Dual Purpose Generator . . . the all purpose gasoline-engine-driven generator that operates high cycle tools, standard universal power tools, plus floodlights. Write for free on-the-job demonstration.

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How the Town of Normal, Illinois

TRIPLED SOFTENING CAPACITY

...of the same softeners

...by changing to PERMUTIT Q

Replacing old-fashioned zeolite with the high-capacity ion exchange resin, Permutit Q, saves Normal over $7,000 a year!

Normal's three automatic softeners were installed back in 1946, before high-capacity Permutit Q was available. Each softener removed hardness from 83,000 gallons of water between regenerations for a daily delivery of 700,000 gallons of softened water.

Recently town officials called in Consulting Engineers, Farnsworth and Conley, of Bloomington, Illinois, who recommended replacing zeolite with modern, high-capacity Permutit Q.

Look at the benefits gained from this change! The capacity of each softener is up from 83 to 270 thousand gallons between regenerations. Salt Consumption – down to about ¼ lb. per thousand grains of hardness removed. Flow Rate–up from 285 to 510 gpm. Regenerations – down from 3 times to once per day per softener.

A change to Permutit Q may effect similar economies for your city. We'll gladly send helpful data.

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WATER SUPPLY • SEWAGE DISPOSAL
INDUSTRIAL WASTE TREATMENT

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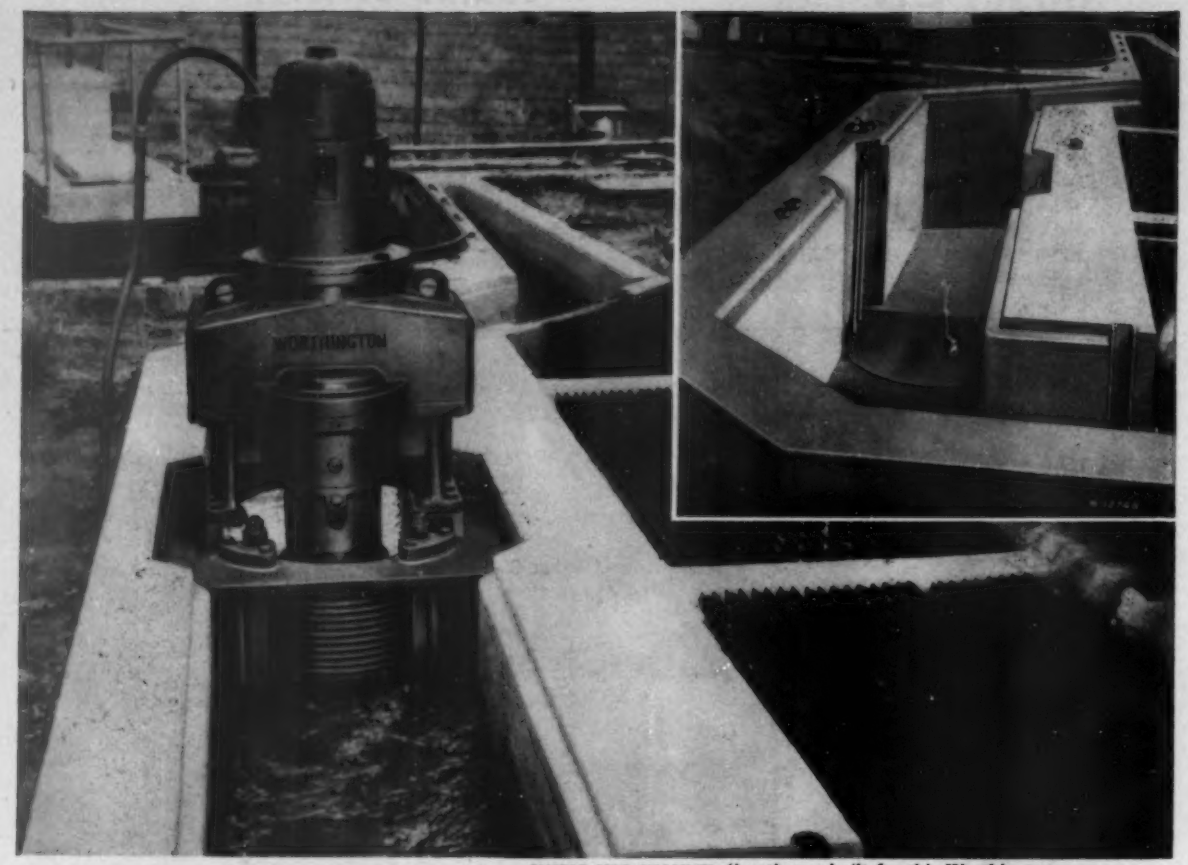

SIMPLE SIDE CHANNEL (inset) was built for this Worthington comminutor at Klamath Falls, Oregon, because Mr. E. A. Thomas, the City Engineer, wanted to use the existing channel as a by-pass.

Low installation cost swings Klamath Falls to Worthington

Since the Worthington comminutor is designed so that raw sewage flows straight through its screen, it's easily installed in a straight rectangular sewage channel.

Result? Expensive masonry work is not needed, which makes for simplified, low-cost installation.

This was an important factor in the selection of a Worthington 25C6 comminutor as part of recent improvements at the Klamath Falls, Oregon, Sewage Treatment Plant.

This comminutor, installed downstream from a grit chamber and upstream from a clarifier, was lifted directly from its packing crate and set right in the channel in a minimum of time.

Easy-to-remove cutter racks for occasional sharpening and the built-in flood protection provided by a mercury seal are other advantages of the Worthington comminutor.

Get all the facts and figures on the rugged Worthington comminutor. Check with your nearest Worthington district office. Or write today for new engineering manual on comminutors, W-317-B17. Worthington Corporation, Public Works Division, Harrison, N.J.

W.A.5

WORTHINGTON

ALL MAJOR PUBLIC WORKS EQUIPMENT UNDER ONE RESPONSIBILITY

Water Works Pumps • Sewage Pumps • Comminutors • Vertical Turbine Pumps • Vacuum Pumps

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United States Pipe and Foundry Company is a wholly integrated producer of cast iron pressure pipe—from our mines and blast furnaces to our strategically located pipe plants.

This should be of major interest to a pipe buyer since it means: (1) complete independence of action in supplying your needs as we produce our own raw materials, (2) greater assurance of continuity of service at all times, and (3) undivided control of quality at every step in pipe production from the ground up.

In addition to being able to control the quality of pipe-making raw materials at their sources, our Quality Control of pipe production gives further assurance to customers that the quality level of U. S. Cast Iron Pipe is in excess of standard specifications. Our pipe is produced to *our own* quality control specifications, more exacting than the established specifications under which cast iron pipe is normally purchased.

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FOR WATER AND SEWAGE AND INDUSTRIAL SERVICE

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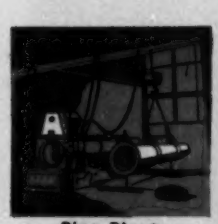
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Consulting Engineers
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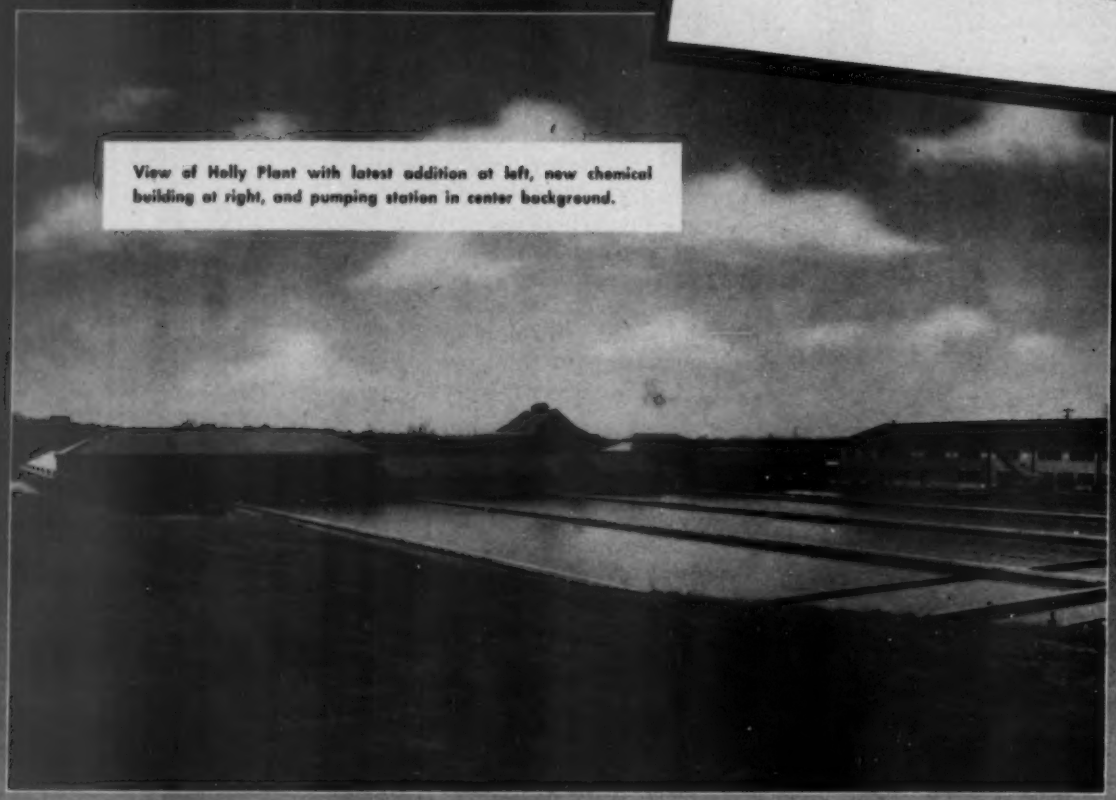


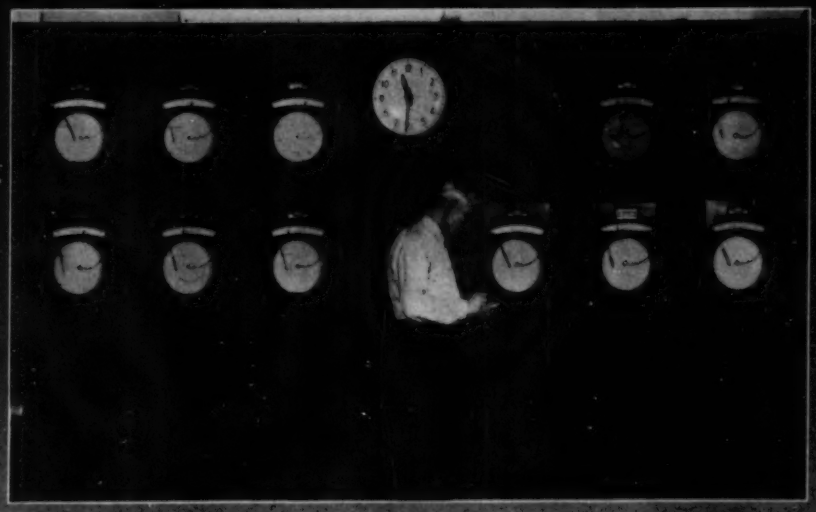
View of Holly Plant with latest addition at left, new chemical building at right, and pumping station in center background.

To keep pace with the dramatic growth of Fort Worth has necessitated almost constant expansion of the city's water supply system. Since World War II, treatment facilities at the Holly Plant have been increased from 35 MGD to the present total rated capacity of 80 MGD. The Holly Plant, to-day, is the center of a multi-million dollar water supply system on which Fort Worth stakes its future.

This plant is operated by W. S. Mahlie, Supt. and Chief Chemist of Water Purification, under the direction of Uel Stevens, Director of the Water Department. The plant incorporates the latest in control and metering equipment by Builders-Providence, Inc., installed under contracts by Ottinger Construction Company, Glade-Friedman-Byrne, Contractors and E. E. Ericson Company, with the assistance of Morey & Morey, Engineers of Dallas, Texas. With the installation of the Builders Filter Controllers, Gauges, Filter Operating Tables, Wash Water Controller, and Chronoflo Transmitters and Receivers, Fort Worth continues a long-standing tradition. Builders equipment has served at Fort Worth since the early 1900's when the original Holly Pumping Station was built. For detailed information on Builders Water Works Equipment, address **BUILDERS-PROVIDENCE, INC., Providence, Rhode Island.**

The new filter gallery showing 16 Builders Filter Operating Tables with Loss of Head and Rate of Flow Gauges, Valve Operating Levers, and Valve Position Indicators . . . for convenient control of each Filter.

Supt. W. S. Mahlie taking readings at the main operating panel in the Holly Plant Filter Building. Panel instruments are Builders Chronoflo Receivers for centralized flow, level, and summated flow metering. Operation is by simple two-wire electrical circuits.



Eight Omega Model UF-2 Universal Volumetric Feeders for feeding hydrated lime and alum. Each feeder is equipped with an extension hopper to confine chemical storage and hopper filling to the floor above.

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DIVISION OF B-I-F INDUSTRIES, INC.

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B-I-F METERS FEEDERS CONTROLS

Take the "sting" out of hydrant damage with DARLING QUIKFIX B-50-B's

HERE'S an unmatched combination for those locations where traffic mishaps are frequent. First, you gain all the unique advantages of Darling's standard B-50-B design, with its ball bearing operation and "O" ring seals. Easier, quicker operation . . . no packing gland maintenance . . . no water seepage to operating threads or bearings . . . no loss of lubricant.

And when destructive impact does occur, Darling's improved breakable barrel and valve rod couplings "take the rap". Both hydrant barrel sections remain undamaged and intact. Moreover, on-the-spot repair is a quick cinch. Note how the barrel coupling is segmented—four pieces —for easiest, minimum part replacement.

Better get *all* the facts about Darling QUIKFIX B-50-B's and see how *much* you can gain and save. Write:

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Manufactured in Canada by The Canada Valve & Hydrant Co., Ltd., Brantford 7, Ont.

"Here's why interchange-ability of American Meter parts is so important to us through the years!"

"Full interchangeability of parts is a must when we consider buying water meters. It means the difference between quick, simple repair jobs and lengthy, expensive servicing. During the last year we replaced worn parts of an AMERICAN METER in operation for thirty years with new parts ordered from the Buffalo Meter Co. I noticed how these parts were interchange-able piece for piece!

"Once we found how easy it is to keep these meters in service, we started replacing all our meters with AMERICAN. We've had hardly any meter problems since!"

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DE LAVAL CENTRIFUGAL PUMPS *bring 68% water reserve to Allentown, Pa.*

These 15 mgd, 288 foot-head centrifugal pumps are among the total of nine De Laval units that provide a new, all-time high in water availability at Allentown, Pa. Full capacity is 42 mgd, present consumption 25 mgd — a "cushion" of 68% against the heavier demands of future years.

Part of the problem in setting up this big, new facility was to utilize as much equipment as possible from the old plant. Here, De Laval versatility paid off, for several units which had already been in use for twenty years tied in easily, economically, with the new system.

More than 80% of America's cities look to De Laval for the utmost in pump performance and dependability. And they profit daily from De Laval's fifty three years of experience in municipal water works pumping. De Laval units range in capacity from 100 thousand to 100 million gallons per day.

DE LAVAL *Centrifugal Pumps*

DE LAVAL STEAM TURBINE COMPANY
824 Nottingham Way, Trenton 2, New Jersey

DL 2297

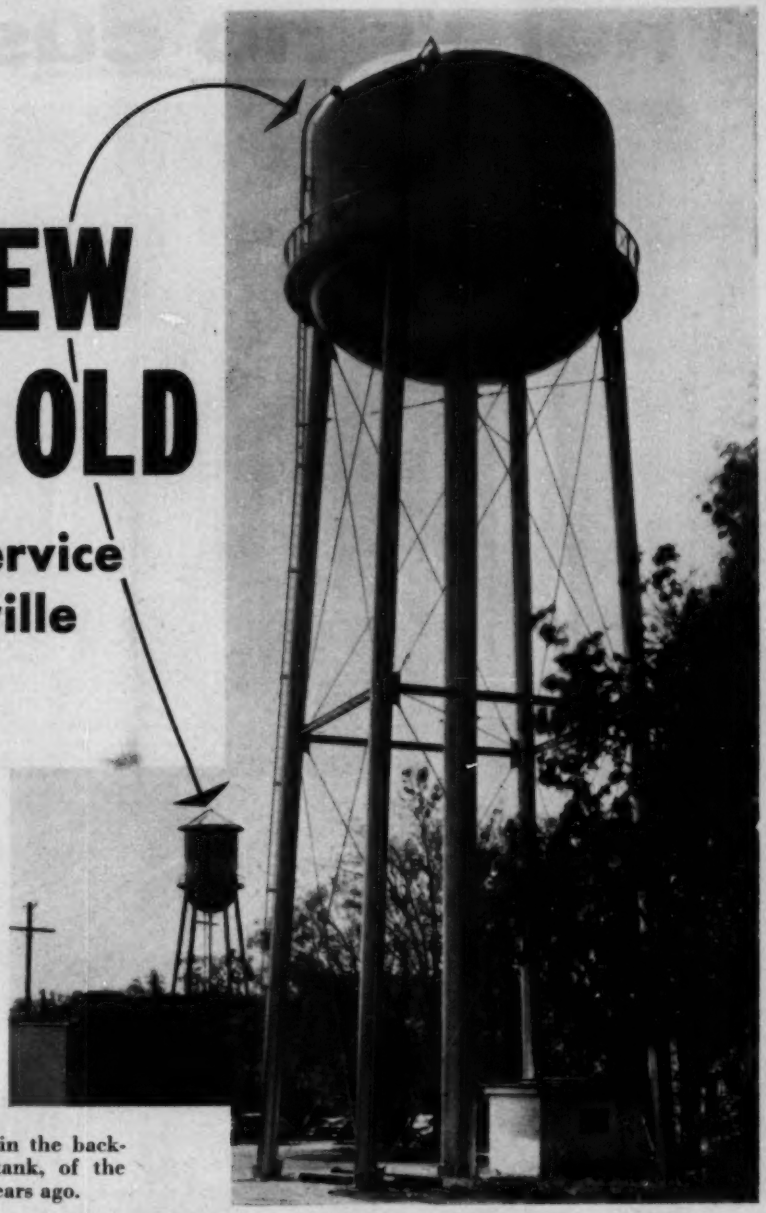
The NEW and the OLD

in water service at Blackville

Shown in right foreground is a 100,000-gal. Horton® ellipsoidal-bottom elevated tank recently installed for municipal water service at Blackville, S. C. Horton elevated tanks of this type are graceful, streamlined structures with cylindrical columns and ellipsoidal roofs and bottoms. Butt welding, used throughout, provides smooth surfaces that are easy to maintain.

By way of contrast, shown in the background, is an old elevated tank, of the style that was popular many years ago.

To bring your municipal water system up-to-date in appearance as well as service, write our nearest office for estimates or quotations on a Horton elevated tank.



New 100,000-gal. Horton elevated tank and an unidentified elevated tank in water distribution system at Blackville, South Carolina.

HORTON

WELDED STEEL STORAGE TANKS

CHICAGO BRIDGE & IRON COMPANY

Plants in Birmingham, Chicago, Salt Lake City, and Greenville, Pa.

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Cleveland 15	2262 Midland Bldg.	Salt Lake City 4	550 West 17th South St.
Detroit 26	1551 Lafayette Bldg.	San Francisco 4	1583—200 Bush St.
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Houston 2	2115 C & I Life Bldg.	Tulsa 3	1640 Hunt Bldg.

There's no customer

Ewing Galloway

This is Detroit—the Automotive Capital of the World.

Bettmann Archive

Old print showing Detroit about a century ago, from the Canadian side of the river.

MODERNIZED cast iron

like an old customer!

DETROIT installed cast iron water mains 116 years ago... and installs them today!

One hundred years ago, Detroit was a city of 40,000. Today it is the Automotive Capital of the World. Today's two million population (estimated) requires over three thousand miles of mains of which 97% are cast iron. Several of these mains are still functioning after a century and more of service. Customers served have increased from 5300 a century ago to nearly 400,000 (city only).

When you have customers with an unbroken record of buying your product for over a century, you naturally prize them. They're scarce in any long-established business or industry. The cast iron pressure pipe industry is proud to have 60 such customers—utilities that have been buying cast iron pipe for water or gas mains for 100 years or more.

Cast iron pipe has been a rugged, long-lived product from the earliest days. Today's *modernized* cast iron pipe, centrifugally cast, is even stronger, tougher, and more uniform in quality. And, where needed and specified, it is centrifugally lined with cement mortar to assure sustained carrying capacity throughout the long life of the pipe.

Cast Iron Pipe Research Association, Thos. F. Wolfe, Managing Director, 122 So. Michigan Ave., Chicago 3.

CAST Q-CHECK IRON

The Q-Check stencilled on pipe is the Registered Service Mark of the Cast Iron Pipe Research Association.

One of several cast iron water distribution mains still functioning in Detroit after a century and more of service.

pipe FOR MODERN WATER WORKS OPERATION

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EDDY can supply replacement parts for any Eddy Valve or Hydrant ever installed! This is important to you because the Valves and Hydrants you buy today must serve several generations yet unborn. You want no "orphans" in your system. Eddy Hydrants and Eddy Valves are backed by Eddy Valve Company's 104 years of dependable operation—your assurance that replacement parts will be available during the years to come.

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San Jacinto Project uses 65 large R-S Butterfly valves

CITY OF HOUSTON SAVES $124,000 with DROP-TIGHT RUBBER-SEATED VALVES

Choosing R-S Rubber-Seated Butterfly Valves* enabled Freese, Nichols & Turner, Consultants on the San Jacinto River project, to save $124,000 for the City of Houston. Use of 65 of these valves for all low-pressure service gave a substantial space reduction and the direct, in-place cash savings over gate valves. SMS cone check valves were also chosen for pump discharge service.

Positive closure in R-S Rubber-Seated Valves is obtained by wedge-type closure of the disk within a one-piece rubber seat. Tough, flexible rubber seals the entire disk seat — including the area around the shaft bosses. Supervised testing of a six inch R-S Rubber-Seated Valve proved that after 6,000 closings the valve was still giving positive shutoff at 100 psig water.

These valves are the product of over 75 years of design and engineering experience in the hydraulics field. To find out more about our complete line—R-S Butterfly, Rotovalves and Ball Valves — write to S. Morgan Smith Company, York, Pennsylvania.

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Pumps
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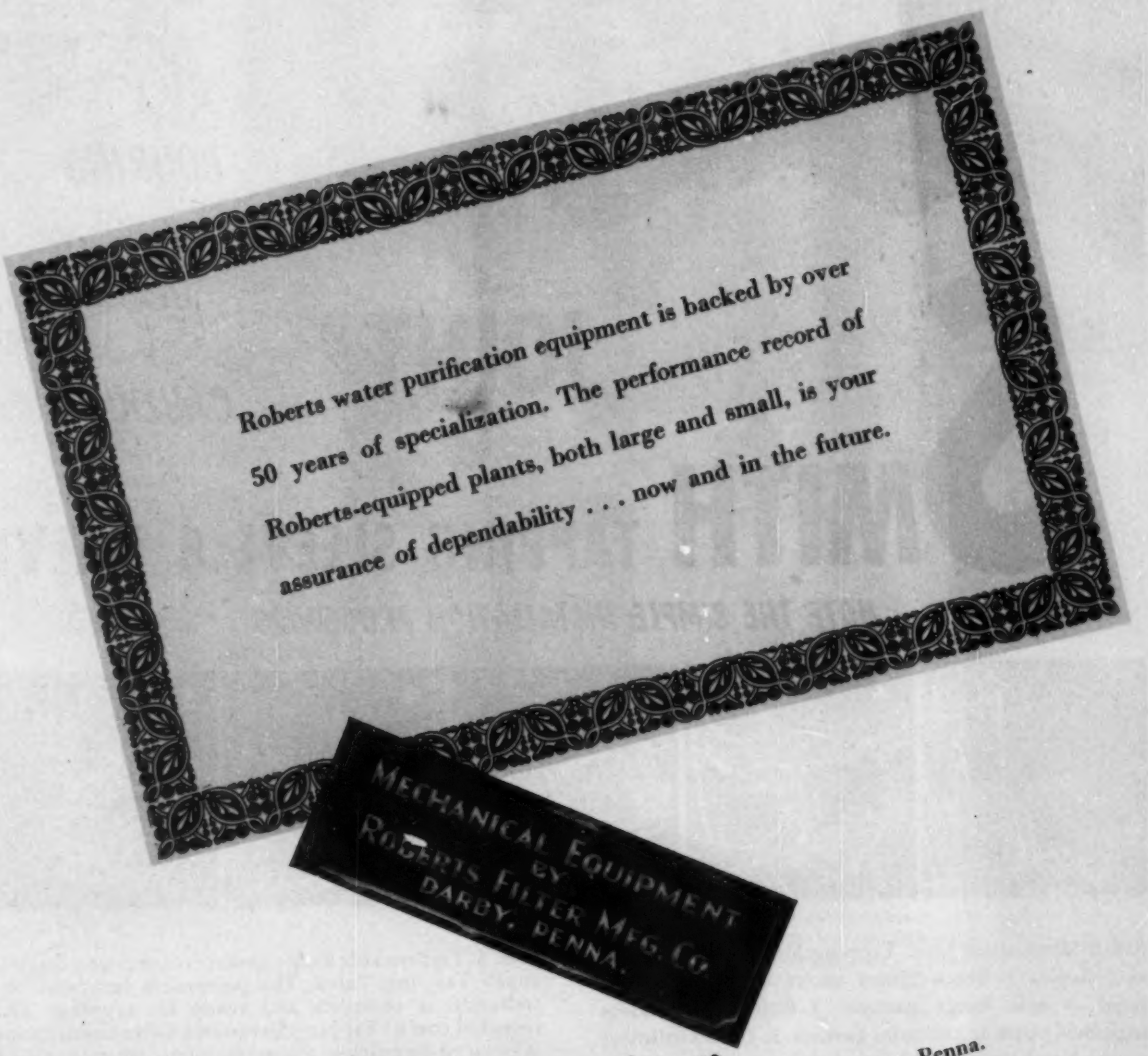
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Roberts-equipped plants, both large and small, is your
assurance of dependability . . . now and in the future.
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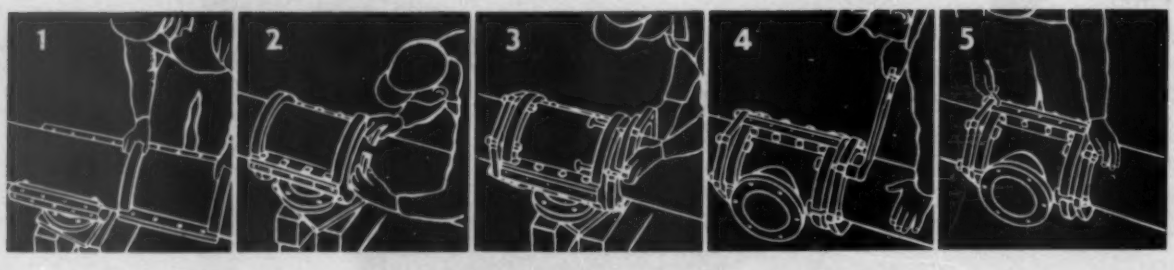
SMITH TAPPING SLEEVE & VALVE

NOTE THE SIMPLE INSTALLATION PROCEDURE



Smith Mechanical Joint Tapping Sleeves are installed as follows: 1. Block Sleeve outlet half under pipe, position side flange gaskets. 2. Bolt Sleeve halves together, position end joint gaskets. 3. Install follower rings, hand tighten bolts and nuts. 4. Rotate Sleeve outlet flange to desired position, tighten follower ring nuts. 5. Tighten side flange gasket compression screws, attach Tapping Valve. The permanent leakproof installation is complete and ready for tapping. The installed cost of Tapping Sleeve and Valve connections is reduced by quicker assembly, elimination of skilled labor and costly jointing material. Bulletin MJ1 will be immediately sent on request.

50

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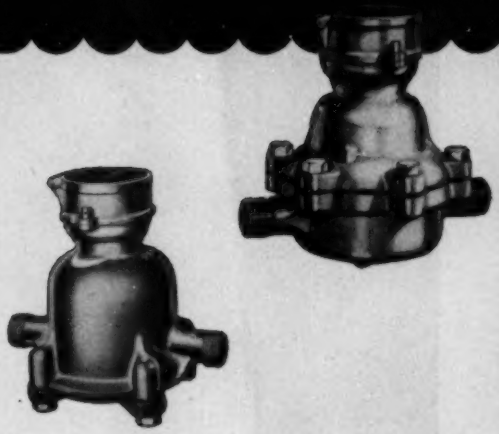
THE A.P. SMITH MFG. CO.

EAST ORANGE . NEW JERSEY

Water is vital...

BADGER meters conserve it BETTER!



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"Measures the water of the world"

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DRESSER®

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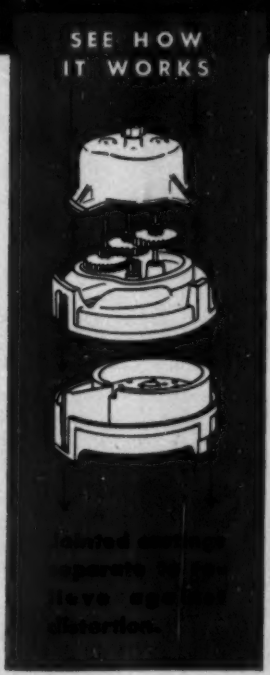
Q- What happens when a Rockwell-Empire Type 12 Meter FREEZES?

A- All interior parts SEPARATE to prevent damage!

In this meter the internal castings are jointed and held together without the use of screws or bolts. Thus, when the meter freezes and the frost bottom breaks, all the parts separate and are free to move with the expanding ice. There is no strain or distortion such as can occur in meters either having parts bolted together or with assemblies that are directly attached to the meter case.

Ask your Rockwell representative to demonstrate this and the many other money-saving, revenue-building features in the Empire Type 12 design, or write for bulletin W-802.



The Symbol for Service, Quality and Performance in Water Meters

ROCKWELL MANUFACTURING COMPANY

PITTSBURGH 8, PA. Atlanta Boston Chicago Houston Los Angeles
N. Kansas City New York Philadelphia Pittsburgh San Francisco Seattle Tulsa

In Canada: Peacock Brothers Limited

G-E Cabinetrol* Panels Are Custom-engineered for Your Exact Specifications

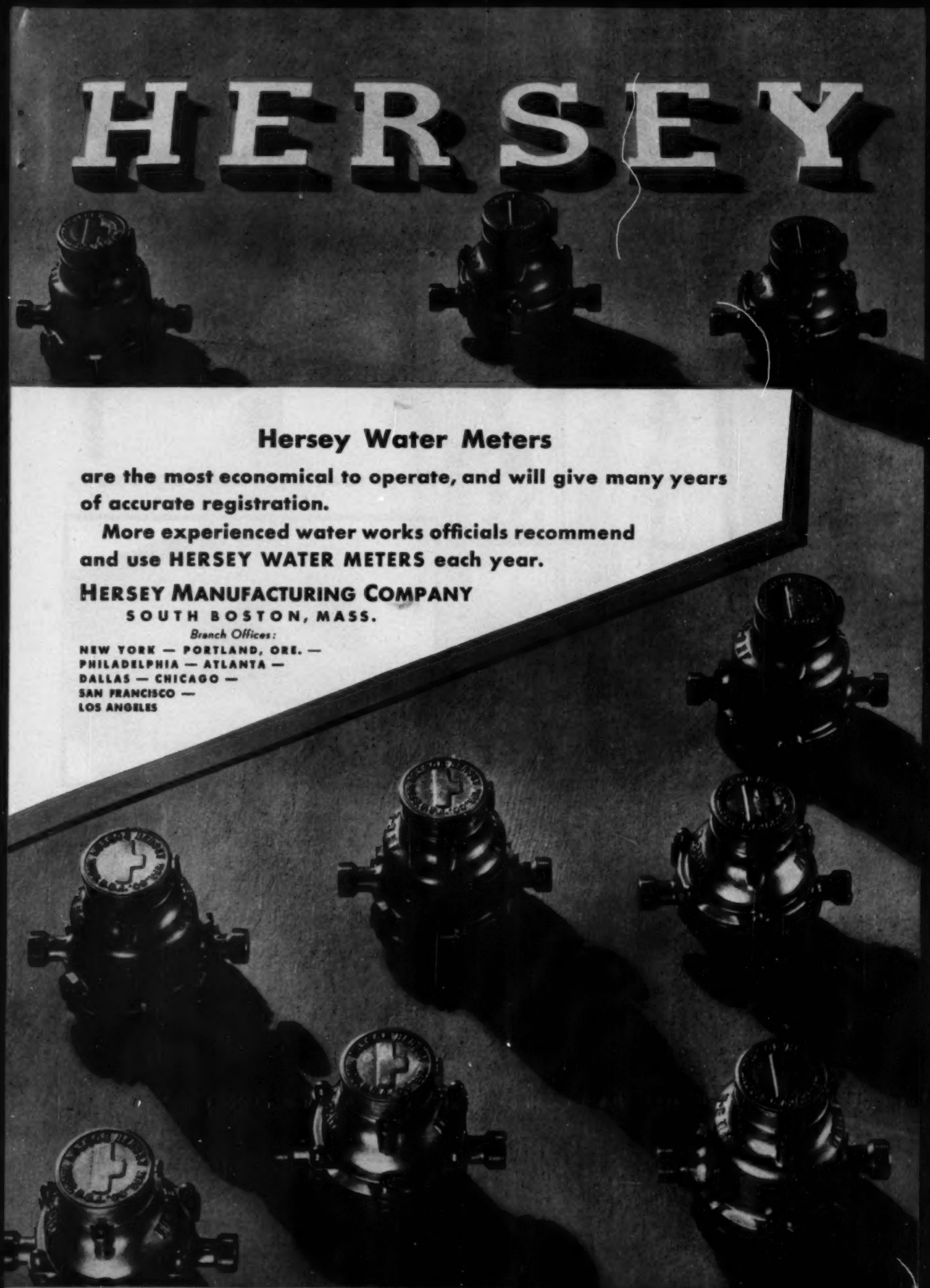
1. **STANDARD COMPONENTS** assure fastest possible production and delivery of your panels. Modern factory techniques speed completion of your order.
2. **YOUR REQUIREMENTS** are followed exactly. Thorough examination and testing assure "job-tailored" performance.
3. **EXPERIENCED G-E ENGINEERS**—working closely with you—design the unit to meet your application.

Cabinetrol panels are not costly, improvised modifications of some other type of control center. These panels form a **standard** low-voltage control system which handles all motor types up to 600 hp from a central location. You get the time-saving and money-saving advantages of standard components which are custom-assembled.

For complete information, contact your nearest G-E Apparatus Sales representative. Or write for the descriptive bulletin, GEA-3856. Section 780-4, General Electric Company, Schenectady 5, New York.

*Reg. trade-mark of General Electric Co.

GENERAL ELECTRIC



Hersey Water Meters

are the most economical to operate, and will give many years of accurate registration.

More experienced water works officials recommend and use HERSEY WATER METERS each year.

HERSEY MANUFACTURING COMPANY
SOUTH BOSTON, MASS.

Branch Offices:
NEW YORK — PORTLAND, ORE. —
PHILADELPHIA — ATLANTA —
DALLAS — CHICAGO —
SAN FRANCISCO —
LOS ANGELES

YOU GET MORE MILS PER GALLON WITH AMERCOAT 33

Amercoat's higher solids content gives you a thicker, heavier coating—more mils for every gallon applied.

THIS MEANS YOU SAVE MONEY TWO WAYS ON MAINTENANCE PAINTING

Lower Material Cost. You save on material because it takes fewer coats of AMERCOAT 33 to build the required film thickness.

Lower Labor Cost. You save on labor because fewer coats mean fewer man hours for application—less down time, too.

In addition to more mil thickness per gallon, you get more protection per gallon. AMERCOAT 33 is formulated specifically for maximum chemical resistance and for severe weathering conditions. In major industries from coast to coast – chemical, petroleum, pulp and paper, food, and many others – maintenance engineers look to AMERCOAT 33 for low cost, long lasting protection for all types of steel or concrete structures.

Amercoat pioneered the development of protective coatings especially designed for severe corrosion problems. Today it is the only organization that offers you... a complete line of corrosion resistant coatings...nationwide distribution... trained technical men to give you on-the-job assistance throughout the United States and Canada.

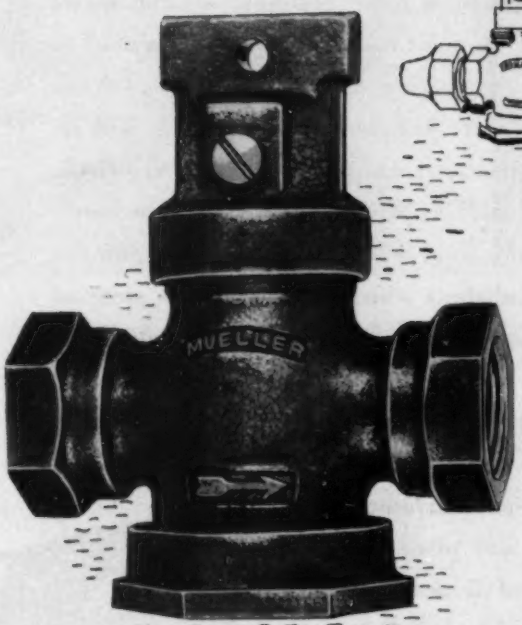
Amercoat CORPORATION
Dept. F,
4809 Firestone Blvd.,
South Gate, California
CHICAGO, ILL. • KENILWORTH, N. J. • JACKSONVILLE, FLA. • HOUSTON, TEX.

Write today for the AMERCOAT 33 Technical Bulletin which gives a complete description of the coating's chemical and physical properties.

MUELLER CURB STOPS

for the finest in...

design...
materials...
workmanship!



Since the founding of Mueller Co. in 1857 by Hieronymus Mueller, the inventor of the tapping and inserting machine and many other products for the water industry, Mueller Co. has been a pioneer in the development of water works products of the highest quality. The quality material and design of present Mueller water works brass goods are a direct result of these years of patient research and testing in the laboratory and in the field.

And, the art of combining fine designs and materials into quality finished products has been an earnest endeavor of Mueller Co. for nearly a century. A great fund of production techniques and craftsmanship makes possible precision brass goods that must pass rigorous tests before they are released to the trade.

Mueller Curb Stops are typical of the excellent design, materials and workmanship found in all Mueller products—many of which have been chosen as "standards" of the Water Works Industry throughout the United States, Canada and many foreign countries.

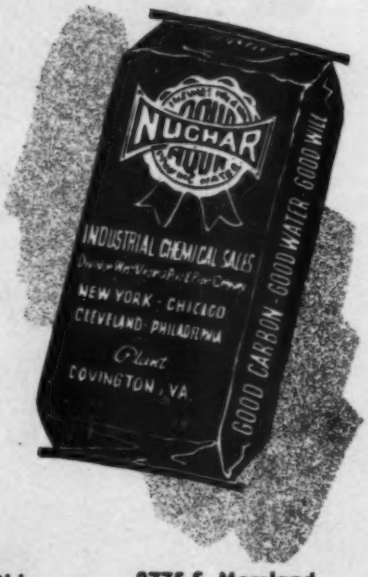
MUELLER CO. *Dependable Since 1857*
Main Office & Factory Decatur, Illinois

Crossing the Threshold is An Important Step..

A Threshold Odor Test is the only known way to evaluate your success in removing disagreeable tastes and odors from your water. Frequent odor surveys are essential to insure *constantly* palatable water. Technicians from INDUSTRIAL, *as part of their regular services*, will assist you in the application techniques of AQUA NUCHAR.

The dosage of AQUA NUCHAR—activated carbon—needed to provide palatable water will depend upon the many varying conditions which determine the state of the raw water supply. Waterworks operators realize that partial reduction of odors may not produce palatable water. In fact, the average individual will be fortunate to detect the difference between waters having Threshold Odor values of 50 and 25. Therefore, sufficient activated carbon must be applied at the right time and place to reduce the threshold number to a value of 5 or less. Complete reduction of detectable odors (Threshold Odor of 5 or less) will eliminate complaints and may even result in compliments on the water quality.

INDUSTRIAL'S Research and Technical Group are available to you (without obligation) when you face odor problems.

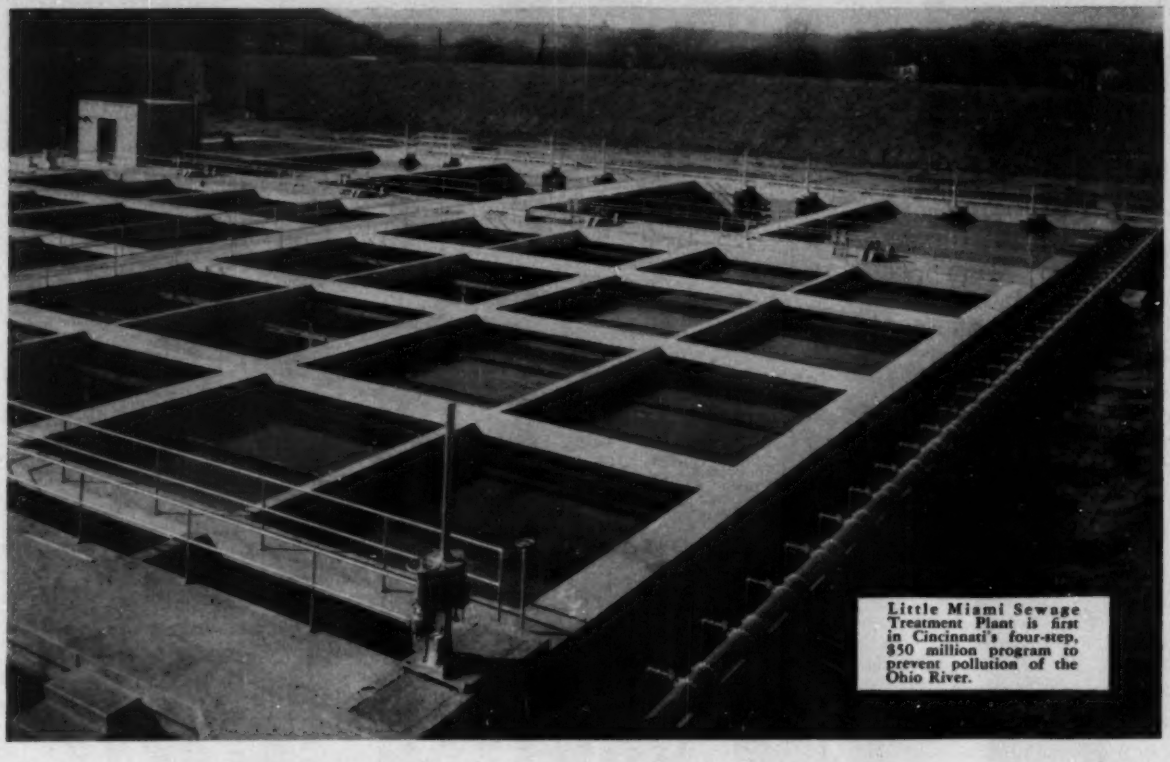


industrial CHEMICAL SALES

division west virginia pulp and paper company

New York Central Bldg. 230 Park Avenue New York 17, N. Y.	Pure Oil Bldg. 35 E. Wacker Dr. Chicago 1, Ill.	Lincoln-Liberty Bldg. Broad & Chestnut Sts. Philadelphia 7, Pa.	2775 S. Moreland Blvd. Cleveland 20, Ohio

VISIT OUR BOOTHS 55-56 — SEWAGE WORKS AND INDUSTRIAL WASTES CONVENTION — CINCINNATI, OHIO — OCTOBER 11-14



Little Miami Sewage Treatment Plant is first in Cincinnati's four-step, $50 million program to prevent pollution of the Ohio River.

It's LINK-BELT collectors and mixers at Cincinnati's new sewage treatment plant

BECAUSE the 900-mile Ohio River is the water supply as well as waste outlet for many communities in the eight states bordering it, Cincinnati's sewage disposal problems had to be resolved with consideration for downstream cities. Havens and Emerson, Cleveland consulting engineers, chose Link-Belt mixing-settling equipment.

The outcome: a treatment system designed for almost complete removal of settleable solids . . . 45 per cent removal of total suspended solids, estimated at 250 parts per million . . . 65 per cent B.O.D. reduction of raw sewage with 270 parts per million. While present flow is 18 mgd, actual capacity is 29 mgd, expected to be reached about 1980.

In both breadth of equipment line and depth of experience, Link-Belt is well qualified to handle your sewage treatment requirements—be they large or small. Our sanitary engineers will be glad to work with your engineers, chemists and consultants to provide the finest in modern water, sewage or industrial liquids treatment.

Link-Belt Straightline mixers and collectors in flocculation compartment (foreground) combine to provide maximum solids removal in shortest time. Link-Belt 30 and 48-in. belt conveyors are also used in processing sludge.

LINK-BELT

SANITARY ENGINEERING EQUIPMENT

LINK-BELT COMPANY: Executive Offices, 307 N. Michigan Ave., Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World. 13.600

Aerial view of new water purification plant, City of Houston, Texas. Freese, Nichols and Turner—Consulting Engineers. Brown & Root, Inc.—General Contractors.

Close-up photograph showing part of Leopold Filter Bottom installation in Houston Plant, prior to the placement of the filter media.

HOUSTON SELECTS LEOPOLD Filter Bottoms for New Water Plant

Constructed at a cost of $5,000,000, the new Water Purification Plant of Houston, Texas, combines many of the latest developments in industrial design with time-proven principles of municipal water treatment. Initially equipped for a capacity of 33 MGD, these up-to-date facilities are built to handle a nominal capacity of 50 MGD and are capable of efficient operation up to 200% of these capacities.

In addition to their use in this ultra-modern plant, Leopold Tile Filter Bottoms are giving dependable, economical service in over 250 plants with a daily capacity of more than 1¼ billion gallons. If you're looking for an economical solution to your underdrain problems, it will pay you to consider all the advantages offered by Leopold. Why not write us today for details.

Check these features of the LEOPOLD Filter Bottom:

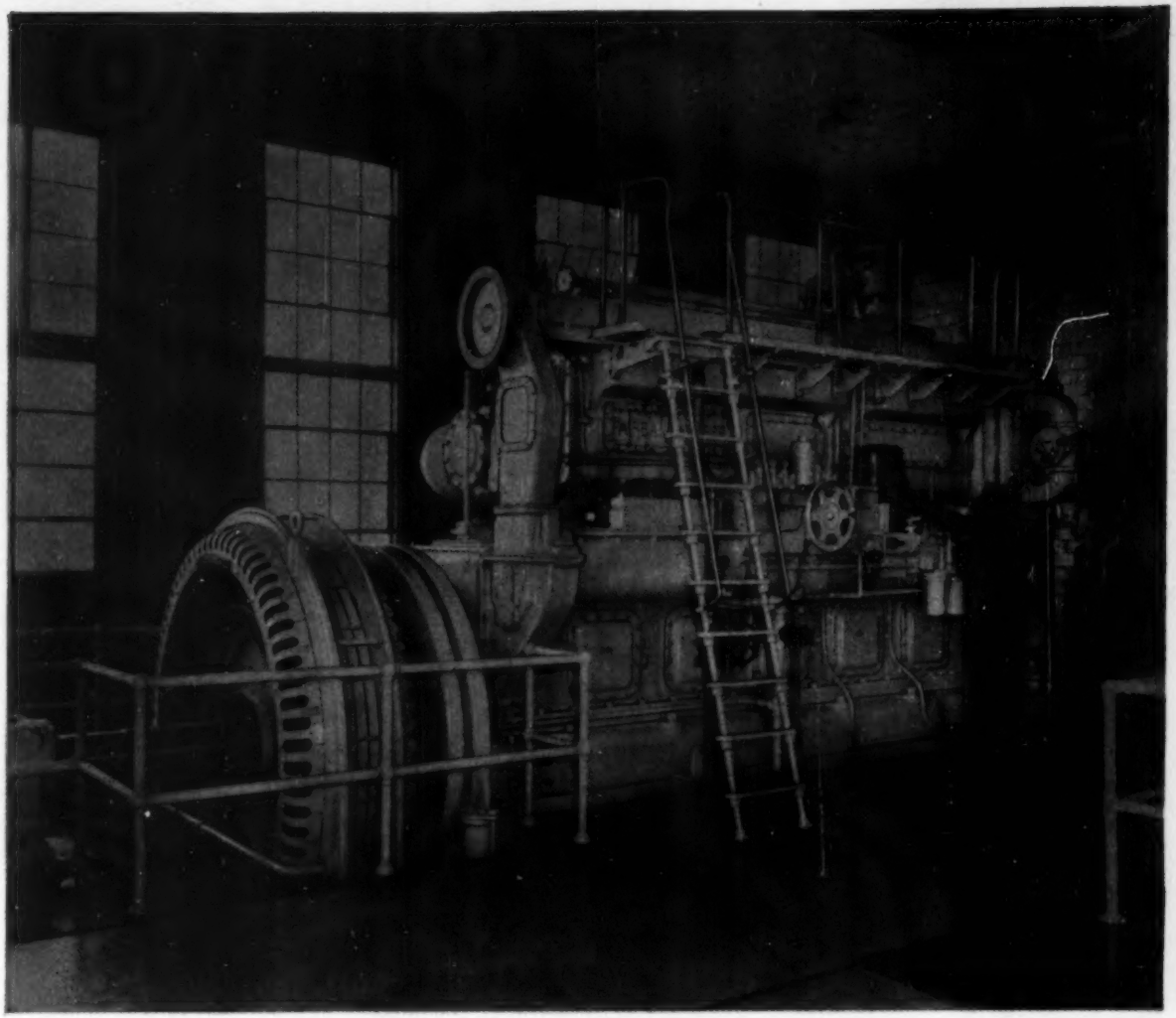
- No possible corrosion or tuberculation anywhere in filter bottom
- De-aired fire clay blocks are practically non-absorbent
- Equal filtration; also equal distribution of wash water over entire bed
- Requires only shallow depth of small-sized filter gravel
- Long life, efficient performance

Leopold

F. B. LEOPOLD CO., INC.

2413 W. CARSON STREET, PITTSBURGH 4, PA.

COMPLETE WATER PURIFICATION AND SEWAGE PLANT EQUIPMENT • DRY CHEMICAL FEEDERS
FILTER OPERATING TABLES • MIXING EQUIPMENT



New Fairbanks-Morse Dual Fuel Engine Retires $150,000 Bond Issue!

When put in service in June, 1950, the 1000-hp. Fairbanks-Morse Model 33FD16 quickly established itself as the most economical engine in the Forest City, Iowa, plant. In a 29-month period, 7,336,260 Kw-h. were generated, at an average fuel cost of 3.89 mills per Kw-h. . . . just half the plant's previous cost. To date the engine has not required a single repair or part replacement.

In producing the majority of Forest City's power, the F-M dual fuel engine's dramatic fuel and lube oil economies and exceptionally low maintenance costs paved the way to a 27 per cent reduction of total plant production costs. As a result of these savings, the plant was able to pay off a revenue bond issue of $150,000 in just 3½ years. Fairbanks, Morse & Co., Chicago 5, Illinois.

FAIRBANKS-MORSE

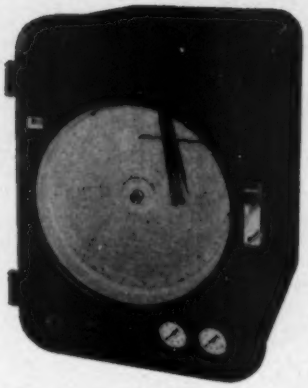
a name worth remembering when you want the best

DIESEL AND DUAL FUEL ENGINES • DIESEL LOCOMOTIVES • RAIL CARS • ELECTRICAL MACHINERY • PUMPS • SCALES • HOME WATER SERVICE EQUIPMENT
FARM MACHINERY • MAGNETOS

for

Reliable Measurement

of low differentials



HAGAN

RING BALANCE METERS

Where flow measurements *must* be made with a low full scale differential, the logical choice is the Hagan Ring Balance Meter. This versatile meter, with no external sealing chambers, is equally useful for flow measurements at low differential or high differential, at high or low pressures.

Consider these advantages of the Hagan Ring Balance Meter

Interchangeable sensing elements, in a complete series, are available for measuring full scale differentials from 1″ to 420″ WC, at static pressure up to 3,000 psig.

The ring assembly is selected for each installation to assure ample power for accurate meter operation at all flows.

The differential range of any ring is adjustable over a 7 to 1 ratio.

The level of sealing fluid in the ring is not critical, the only requirement being sufficient depth to seal against maximum differential.

Calibration, using dead weights, takes only a few minutes. It is not necessary to disconnect the meter from the line.

Automatic compensation for such variables as temperature, pressure or fluid density is a standard attachment.

Pneumatic or electric signal transmission is available for remote recording or automatic control.

The Hagan Ring Balance Meter is the most versatile design available for flow measurements with any source of differential—orifice plate, venturi tube, pitot tube, weir or flume.

We will be glad to suggest the metering equipment best suited for improving existing facilities, or for extensions and new construction.

HAGAN HALL BUROMIN CALGON

HAGAN CORPORATION

Hagan Building • Pittsburgh 30, Pennsylvania

Boiler Combustion Control Systems • Ring Balance Flow and Pressure Instruments • Metallurgical Furnace Control Systems Control Systems for Automotive and Aeronautical Testing Facilities

WRIST-ACTION DIPPER GIVES NEW ANGLE TO TRENCH DIGGING, ADDS 50% MORE POWER!

Note how wrist action brings dipper mouth in "face-up" position — helps keep big loads from spilling. Wrist-action dipper is available in 18-in. and 12-in. dipper widths.

BUCYRUS-ERIE OFFERS another outstanding feature in dragshovel performance — the wrist-action dipper. Dipper is hinged at lower end of dragshovel handle and rotates in a vertical plane through an arc of 65 degrees, from a position 25 degrees ahead of handle to 40 degrees behind it.

Wrist action permits operator to vary the dipper's position so that dipper teeth bite into ground at best digging angle. You not only get bigger loads but also less spillage because dipper can be rotated to best carrying position. Wrist action provides these additional advantages, too:

1. Actual increase of 50% more power delivered at dipper lip — means up to 6 tons of tooth force.

2. The wrist-action Hydrohoe can dig a vertical wall or short, deep trenches (deeper than they are long) with virtually no hand work; dig column footings; cut trenches 12 to 24 inches wide by as much as 13 feet deep.

3. By working wrist action along with boom telescope, operator can pry out rocks and expose buried pipe with far less danger of pipe damage.

4. Wrist-action dipper rotates past stationary door providing automatic ejection of sticky materials — results in more and bigger payloads.

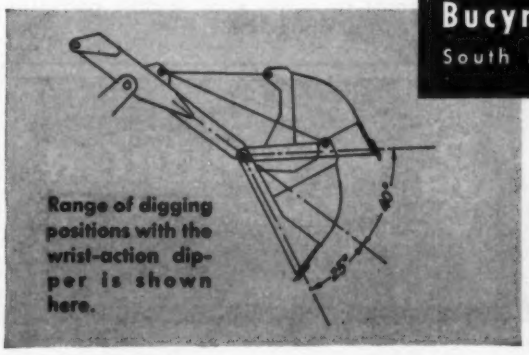
5. Over-all performance is improved by increasing power available at dipper. You have to see this wrist-action dipper in operation to see how it bites in and pries its way through tough clay. It's a real time and money saver.

BUCYRUS ERIE

QUICKLY CONVERTIBLE TO HYDROCRANE IN FIELD

The hoe boom is quickly convertible to crane front end right in the field. With telescoping crane boom this machine has proved outstanding for unloading and laying pipe. Owners say there's nothing like it on pipe handling work.

Get full details on the new Hydrohoe wrist-action dipper and the versatile Hydrocrane. Learn how attachments can be interchanged in minutes. Send coupon today.



Range of digging positions with the wrist-action dipper is shown here.

Bucyrus-Erie Company
South Milwaukee, Wisconsin

Gentlemen:
Please send me details on the new Hydrohoe ☐
Hydrocrane ☐

Name.....

Organization.....

Address.....

City..... State.....

9H54

Here's how you can stop Sewage Corrosion before it starts!

Corrosive acids, alkalis and salts won't ever get a chance to eat up this sewage settling tank! It's being coated with *Pitt Chem* 103—the coal tar coating that stands up to punishment no ordinary paint can handle.

Pitt Chem Cold Applied Coatings give you three unique advantages:

1. They out-last ordinary paints by many times. Yet they cost no more per gallon.
2. They're easy and economical to apply. Your own men can learn how to apply them in a few minutes.
3. *Pitt Chem* forms a tight, lasting bond with metal, masonry, cement and stone.

It all adds up to this fact: *No other material does such a complete job of protection at so little cost.* ● Why not call in a Pitt Chem corrosion engineer to survey your sewage corrosion problems. There's no cost or obligation.

WAD 5046

PITT CHEM 101—For Severest Conditions
PITT CHEM 102—Maintenance Coating
PITT CHEM 103—General Purpose Coating
PITT CHEM 104—Potable Water Service
PITT CHEM 105 AQUATAR—A Water Dispersion
PITT CHEM 106 TARMASTIC—Sealing Compound
PITT CHEM 107 PACHKOTE—Specialty Coating
PITT CHEM 110—Specialty Coating

PITTSBURGH
COKE & CHEMICAL CO.

COAL CHEMICALS • AGRICULTURAL CHEMICALS • FINE CHEMICALS • PROTECTIVE COATINGS • PLASTICIZERS • ACTIVATED CARBON • COKE • CEMENT • PIG IRON

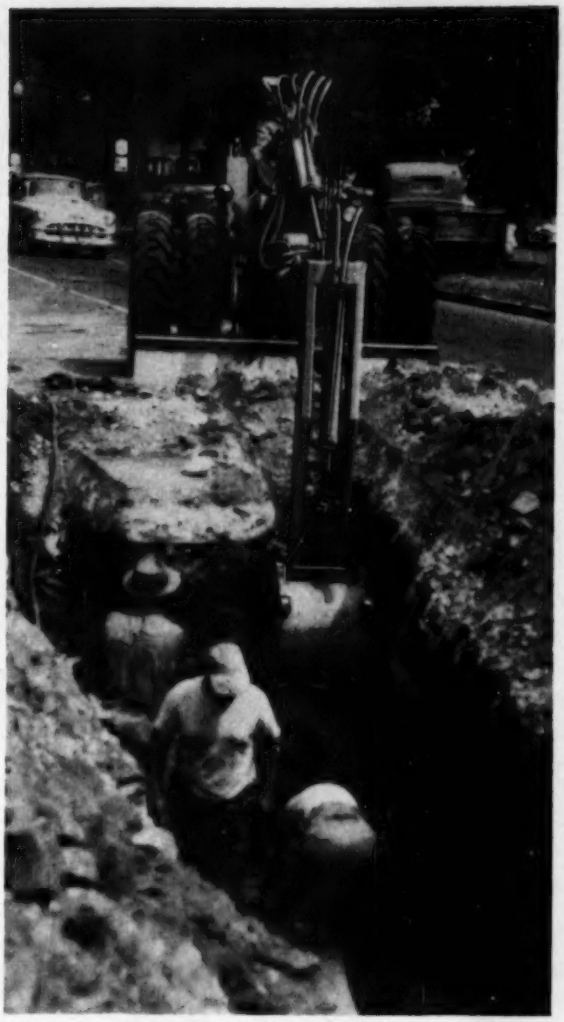
NEW OLIVER 88WT Hydro-Trencher

Digs to 10 feet in toughest going!

Here is a trencher that won't stop when it comes to rocks or roots. Tremendous hydraulic down pressure forces the half-yard bucket into the ground for a fast, full load. New dual-circuit control gives constant pressure, more positive control and greater flexibility in any kind of going.

Take a close look at this new trencher. It reaches long and digs deep. Its simple, sturdy construction and all-hydraulic operation give low maintenance and long service. The hydraulic stabilizer blade not only holds the tractor level and steady, but is an excellent back-filler blade. And, by simply turning the trencher bucket around you have an efficient swing loader.

Test the new Oliver 88WT Hydro-Trencher on your work. See how easy it is to operate and how readily it digs or loads the toughest material. And remember, the 88WT is ready to work or move instantly, and takes only one man to operate. Get in touch with your Oliver Industrial Distributor for a demonstration, soon!



Right through the roadbed! Powerful hydraulic down pressure digs through this material with ease. Positive dual-circuit control gives a choice of *three* separate lift or drop speeds on the boom for any condition. Bucket rotation and dipper stick design permit clamping rocks larger than the bucket itself. Special boom cylinder available for digging to 12 feet.

It's a swing loader, too! Remove the bucket hinge pin and turn the bucket around. In minutes the trencher becomes a loader. No extra parts are needed. The exceptional bucket rotation permits loading into a truck up to 10 feet, 6 inches. Optional loading bucket loads up to 12 feet.

One-half yard bucket! The fast hydraulic operation and big bucket capacity of the 88WT let you do more in less time. All-hydraulic operation means, too, that there are no expensive cables or clutches to replace. Maintenance is simple and low cost.

THE OLIVER CORPORATION

400 West Madison Street, Chicago 6, Illinois

You Can't Beat Steel Pipe for Strength

Bethlehem Tar-Enameled Steel Pipe is widely used for water and sewage service because of its resilience, resistance to shock and corrosion, and leakproof joints. But the most important reason for its popularity is its great strength, which is evident in the chart below.

The chart shows the theoretical working and bursting pressures for various pipe diameters and thicknesses. The pressures shown are based upon the use of steel conforming to ASTM Specification A-283, Grade B, having a minimum ultimate tensile strength of 50,000 psi. When exceptionally severe internal working pressures are encountered, the use of higher strength steel is recommended for greater economy. The nearest Bethlehem office will be pleased to supply complete information.

THEORETICAL INTERNAL PRESSURES OF STEEL PIPE

	1/4 in.			5/16 in.			3/8 in.			7/16 in.			1/2 in.		
DIAM	WT LB/FT	MAX WRK PRESS PSI	MIN BURST PRESS PSI	WT LB/FT	MAX WRK PRESS PSI	MIN BURST PRESS PSI	WT LB/FT	MAX WRK PRESS PSI	MIN BURST PRESS PSI	WT LB/FT	MAX WRK PRESS PSI	MIN BURST PRESS PSI	WT LB/FT	MAX WRK PRESS PSI	MIN BURST PRESS PSI
18	49	445	1390	61	555	1735	73	665	2080	85	775	2430	96	890	2780
20	54	400	1250	68	500	1560	81	600	1875	94	700	2180	107	800	2500
22	63	365	1135	78	465	1420	93	550	1700	109	640	1985	124	730	2270
24	69	335	1040	86	420	1300	102	505	1560	119	585	1820	136	665	2080
30	86	270	835	108	340	1040	129	405	1250	150	475	1455	170	535	1670
36	106	225	695	130	280	870	155	340	1040	181	395	1210	206	445	1390
42	119	195	595	148	240	745	177	285	890	206	335	1040	234	380	1190
48	137	170	520	171	210	650	203	250	780	236	290	910	268	330	1040
54				192	190	580	230	225	695	267	260	810	303	295	925
60				214	170	525	255	200	625	296	235	730	336	265	835
72							309	170	520	359	195	605	408	220	695
84							357	145	450	412	170	520	470	190	595
96	The recommended minimum wall thickness is approximately the pipe diameter divided by 165. Pipe having this diameter-thickness ratio, when backfilled and properly tamped, will withstand any depth of cover. For buried pipe, the recommended minimum thicknesses are shown immediately above heavy black line.									470	145	455	539	165	520
108													*611	150	465
120													*669	135	415

*Under certain conditions stiffeners may be required to reduce deflections.

$$P = \frac{t \times T_s}{r}$$

P = internal pressure, psi
t = thickness, in.
Ts = allowable unit stress = 60% x 27,000 (yield point) = 16,000 psi
r = radius of pipe, in.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM *Tar-Enameled* STEEL PIPE

Another
sewage disposal plant calls on
WROUGHT IRON PIPE
for protection against corrosion

This new $5,500,000.00 City of Cincinnati Sewage Disposal Plant adds another to the growing list of plants—large and small—where wrought iron pipe is helping to maintain operational routine, reduce maintenance and costly repairs and replacement.

Havens & Emerson, Cleveland, Ohio, were engineers on the project; L. E. Stevens, Newport, Ky., was the plumbing and heating contractor.

Our bulletin, *Wrought Iron for Sewage Treatment and Disposal Installations,* gives the complete story of wrought iron protection, and illustrates a variety of services where it is serving longer, at lower cost per year. Write for your copy.

The pipe that lasts the longest, costs the least . . .

The only *valid comparison* of piping costs is INSTALLED COSTS *plus* REPAIRS. This yardstick places the emphasis where it rightly belongs . . . on SERVICE LIFE. In installation after installation, wrought iron pipe has doubled, tripled and even quadrupled the useful service life previously obtained from low-first-cost piping. All this adds up to one thing . . . wrought iron gives you *piping economy,* because it lasts longer, at lower cost per year!

A. M. Byers Company, Pittsburgh, Pa. Established 1864. Boston, New York, Philadelphia, Washington, Atlanta, Chicago, St. Louis, Houston, San Francisco. Export Department: New York, N.Y.

BYERS

CORROSION COSTS YOU MORE THAN WROUGHT IRON

WROUGHT IRON

TUBULAR AND HOT ROLLED PRODUCTS

ELECTRIC FURNACE QUALITY STEEL PRODUCTS

"Century" Pipe installation, Brookwood Estates, Stanhope, N. J.

PERMANENT STRENGTH

"CENTURY"® PIPE

as its name suggests, retains its great strength for generations. One reason is that the materials used to make it (asbestos fiber and portland cement) are themselves inherently strong and durable. Secondly, K&M maintains rigid quality control throughout the manufacturing process. To be certain of high strength and uniformity of construction, K&M tests every length, both hydrostatically and in flexure, before it leaves the plant. "Century" pipe has proved its strength by long service in many kinds of soil.

Consider the many other distinct advantages of "Century" pipe and you'll see why more and more thrifty towns are choosing it—why it's the wise choice for your community too!

Write for further information now.

QUALITIES THAT MAKE "CENTURY" PIPE ECONOMICAL, TROUBLE-FREE, LONG-LIVED

1. NON-TUBERCULATING
2. NON-CORROSIVE
3. PERMANENT STRENGTH
4. DURABLE
5. IMMUNE TO ELECTROLYSIS
6. TIGHT JOINTS
7. SMOOTH BORE
8. EASILY, QUICKLY LAID
9. LIGHT WEIGHT
10. LOW COST

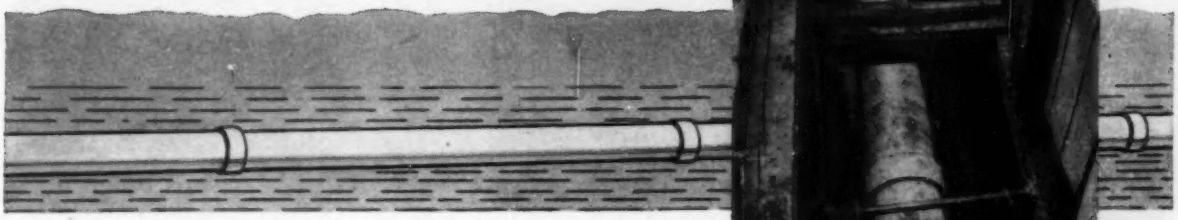
"Century" pipe meets the A.W.W.A., A.S.T.M. and Federal Specifications for asbestos-cement pressure pipe.

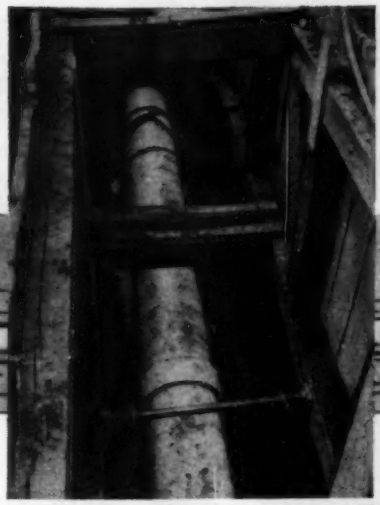
KEASBEY & MATTISON COMPANY • AMBLER • PENNSYLVANIA

Nature made asbestos . . . Keasbey & Mattison has made it serve mankind since 1873

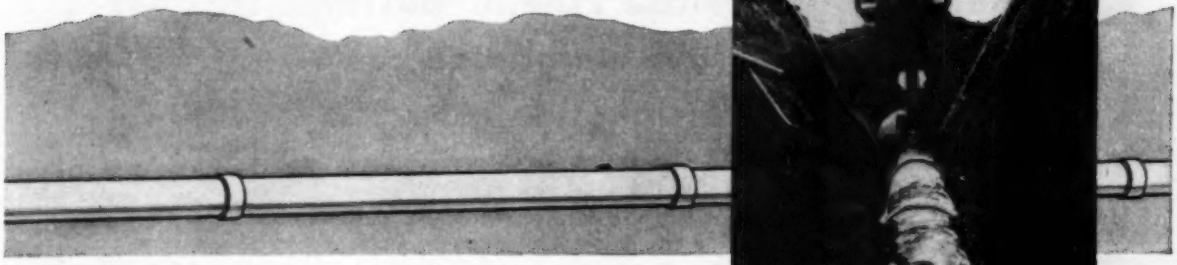
K&M best in asbestos ®

Low land, flat grades?
High water table?





Rolling land?
Excavation problems?



Whatever the problem—

Transite® Sewer Pipe

speeds installation, cuts operating costs

IN a wide range of conditions, Transite Sewer Pipe and its Ring-Tite Coupling provide installation and operational *plus-advantages* that add up to important cost savings.

[Flow Coefficient n–0.010] For instance, with Transite Sewer Pipe, specified velocity of flow can be attained at a minimum grade. Initial savings may also be reflected in smaller pipe sizes. Its unusually low flow coefficient (n=0.010 derived from the Manning formula) makes this possible. This means less cubic yards of excavation, and may also mean . . . elimination of pumping . . . location of treatment plant at higher elevation . . . lower installation costs especially if in wet or ground-water conditions.

[Tight Joints] Where ground water conditions exist (due to a constant water table or during seasonal rains) Transite's Ring-Tite Couplings are *tight* . . . thus treatment-plant dollars are spent to treat *normal* sewage only, not excessive and unnecessary infiltration.

[Strength] Made of asbestos and cement, Transite Sewer Pipe is strong and durable. It withstands heavy load stresses, eliminates expensive cradling in many cases. It is available in two strength classifications.

Transite Sewer Pipe is easily handled, quickly assembled and lowered into trench where it adjusts more accurately to line and grade. The Ring-Tite Couplings are easily and quickly pulled, forming tight, flexible joints that *start* tight and *stay* tight.

For your copy of TR-94A, the helpful widely used Sewer Design Flow Chart, based on the Manning formula, write Johns-Manville, Box 60, New York 16, N. Y.

Johns-Manville TRANSITE SEWER PIPE

THE PIPE WITH THE TIGHT JOINTS

~~MILLS PLASTIC~~ BUTYRATE III does jobs metal pipe can't do. Often cuts installation costs 50% and more

Mills Plastic III pipe weighs only about 1/10 as much as metal pipe of the same diameter, yet it takes on the toughest jobs. It speeds installations amazingly because it can be cut with an ordinary hand saw, and can be quickly joined with Milex fittings and Mills Plastic III Solvent. (The simple technique is shown at right. Flange adapter unions are available to adapt from S.W.P. sizing to iron pipe thread where required. Ask your distributor for details, or write for new booklet describing all Continental Mills Plastic piping, tubing and fittings.

PETROLEUM — Here's the ideal pipe for refinery discharge, crude oil, sour crude, salt water and natural gas.

UTILITIES — Easily installed in corroded gas lines by push- or pull-through methods. Eliminates trenching and repaving.

INDUSTRY — Successful where corrosive liquids or mineral depositions damage other pipe. Smooth walls increase flow rate.

AGRICULTURE — Installing stock watering lines, sprinkler systems and irrigation lines becomes a one-man job with Mills Plastic III.

1. Wipe pipe end with Mills Plastic III Solvent.

2. Wipe inside of fitting with Mills Plastic III Thinner.

3. Insert the pipe end into the prepared slip fitting.

4. The job's done. Pipe can be handled in minutes!

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MILLS PLASTIC PIPE DIVISION
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22 Minutes

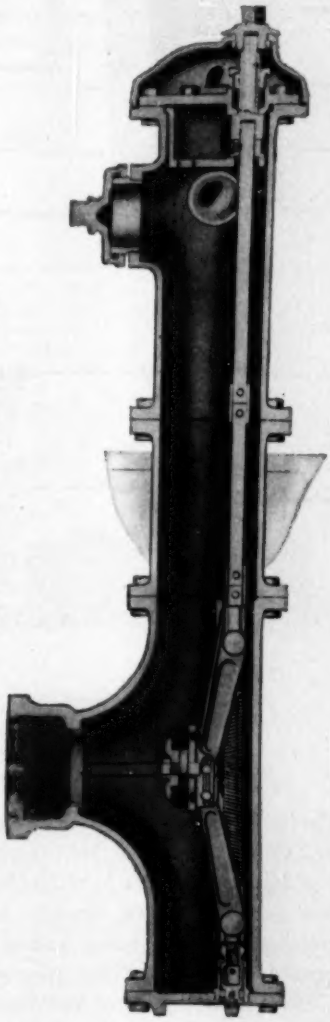
FOR COMPLETE HYDRANT INSPECTION

with Rensselaer

The illustrations show how easy it is to remove and inspect the entire mechanism of the Rensselaer-Corey Fire Hydrant which has been the standard in many cities for more than half a century.

The parts can be removed, inspected and replaced in twenty-two minutes. No digging for repairs or for standpipe breakage. This hydrant opens with the pressure, by means of the powerful knuckle joint. Easy to operate and cannot stick. It is quick opening with free flow long radius curves. Hydrant will not flood.

Ask for Catalog No. G and see why the Rensselaer-Corey Hydrant is preferred by superintendents, fire chiefs and maintenance men. 109



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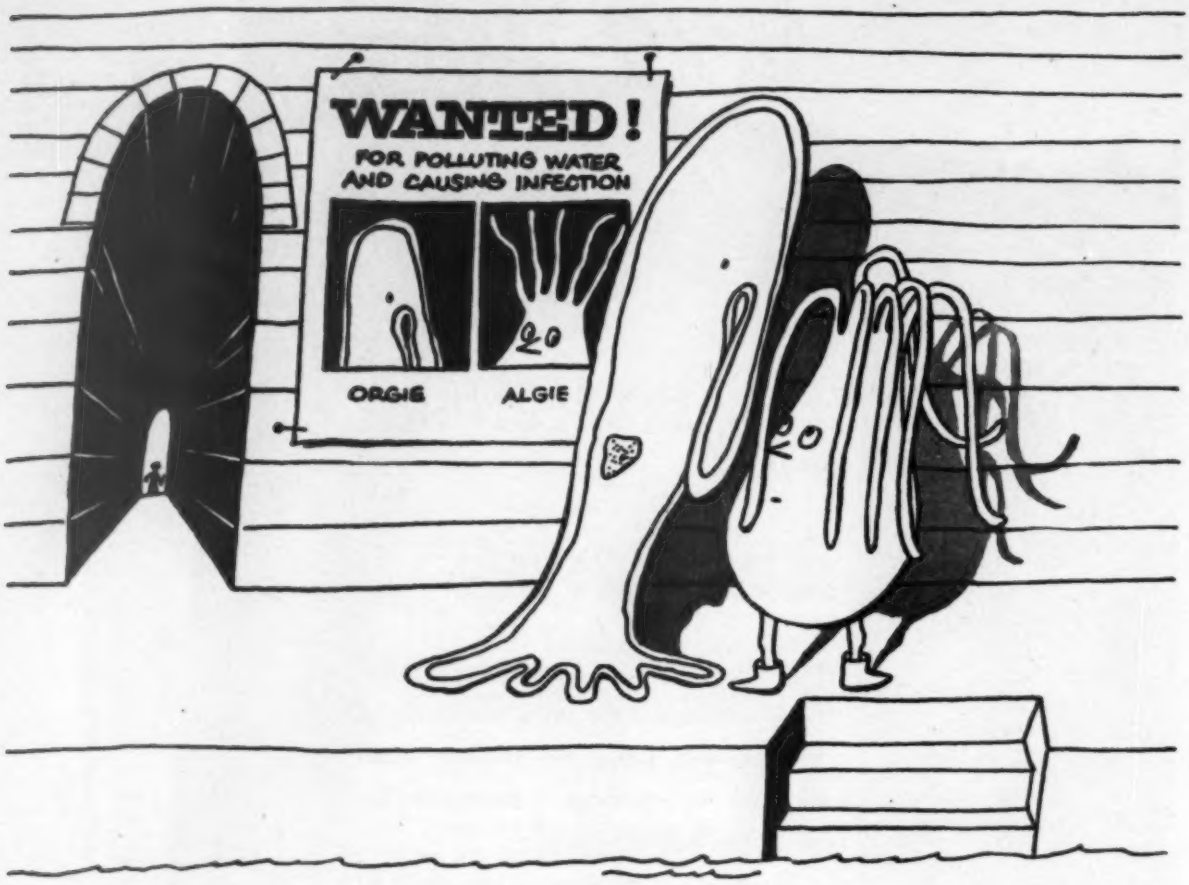

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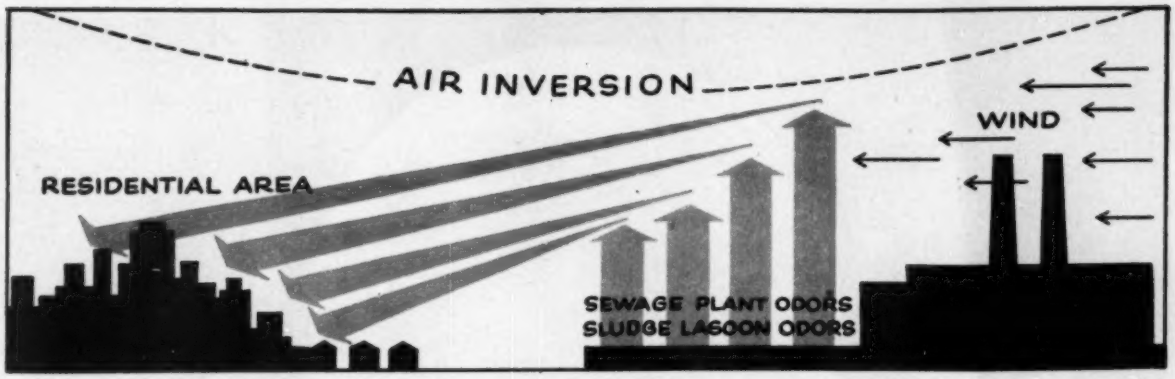
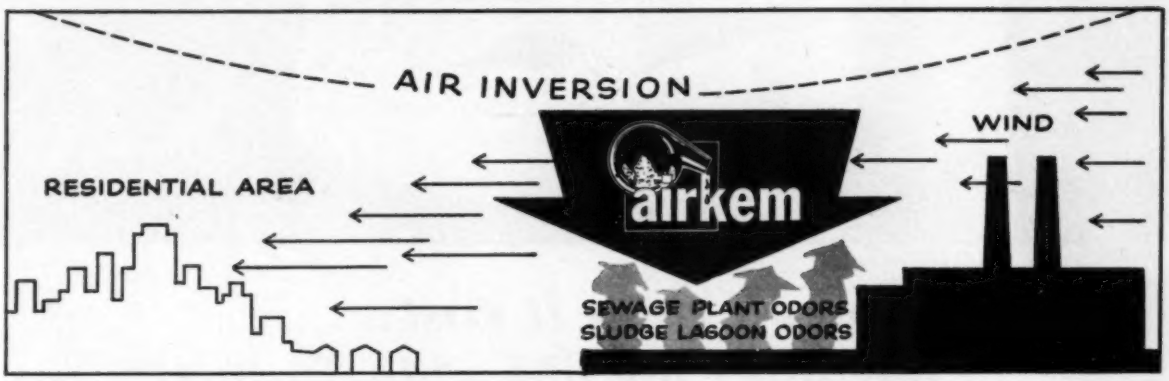


A multi-million-dollar sewage treatment plant was in trouble. Despite "care, cleanliness and chlorine," unpleasant odors were invading the homes of 30-thousand nearby residents.

AIRKEM took this problem and solved it!



Stumped for an economically-sound solution, officials called in Airkem's Industrial Odor Service. After carefully analyzing the problem, the odor trouble-shooters installed simple, low-cost equipment for dispensing a new Airkem product formulated specifically to counteract airborne sewage odors.

Results were immediate and gratifying. The odors were gone. And not only were good relations re-established with the neighbors, but the plant staff was pleased as punch with their improved working conditions. Best of all, the results had been accomplished at moderate cost and without affecting plant operation.

If odors are damaging your plant's public relations, it will pay you to call in Airkem's Industrial Odor Service specialists. They have the low-cost answers to sewage odor problems of widely differing types and degrees of complexity. And behind them are the facilities of the world's largest laboratory devoted exclusively to the study and solution of odor problems.

Consultations are strictly confidential, incur no obligation. Call your local Airkem representative now (he's listed in your phone book), or write today to Airkem, Inc., 241 East 44th Street, New York 17, N. Y.

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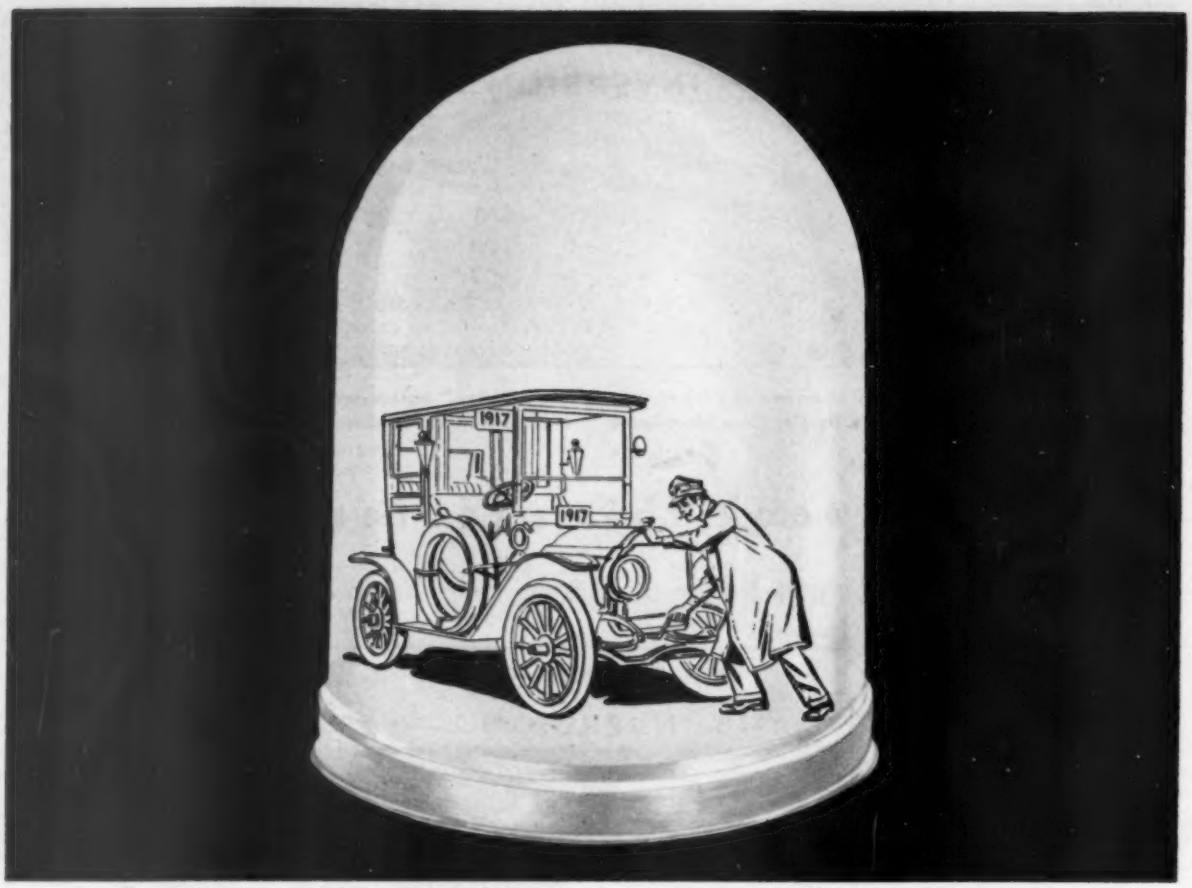

how much does it cost... to "crank" an old chlorinator?

The automobile self-type starter isn't news any more—nobody ever cranks a car these days. "Cranking" an old-style chlorinator is equally out-dated.

The F&P mechanical, instrument-type chlorinator is sweeping the country, sales mount month by month. Why? Because municipality after municipality, consulting engineer after consulting engineer, reports the same facts: F&P chlorinators are lower in first cost, are easier to handle, because they are so simple in design, so light in weight, so modern in construction. More important, however, it is always stressed that F&P chlorinators require practically no maintenance, practically no spare parts.

We claim that if you are operating a chlorinator that has a bell jar on it *you need a new chlorinator.* You are "cranking" an old, costly, inefficient chlorinator. Everybody knows that dry chlorine is not corrosive—but that as soon as you put the chlorine in contact with water or water vapor it becomes corrosive. That's what the water tray types of chlorinators do—put dry, non-corrosive chlorine in contact with water and make corrosive vapor out of it. It's not engineering sense and the way to avoid it—and the resulting expensive maintenance—is to get F&P *mechanical, instrument type* chlorinators.

Don't refrain from writing us because you don't need additional chlorinating capacity right now. Moreover—if it is time for a major overhaul or a rebuilding of your bell jar chlorinator, let us quote you for doing this work. We will give you what you may not have gotten previously—a firm price for doing the job before we start on it. The price will be a reasonable one, but we'll also quote you a price for replacing the chlorinator and if you want to spread the cost of the new one by time payments or if you want a lease arrangement, you can have it. Chances are you cannot justify further overhaul or further rebuilding—even at our *fair* price for doing the work.

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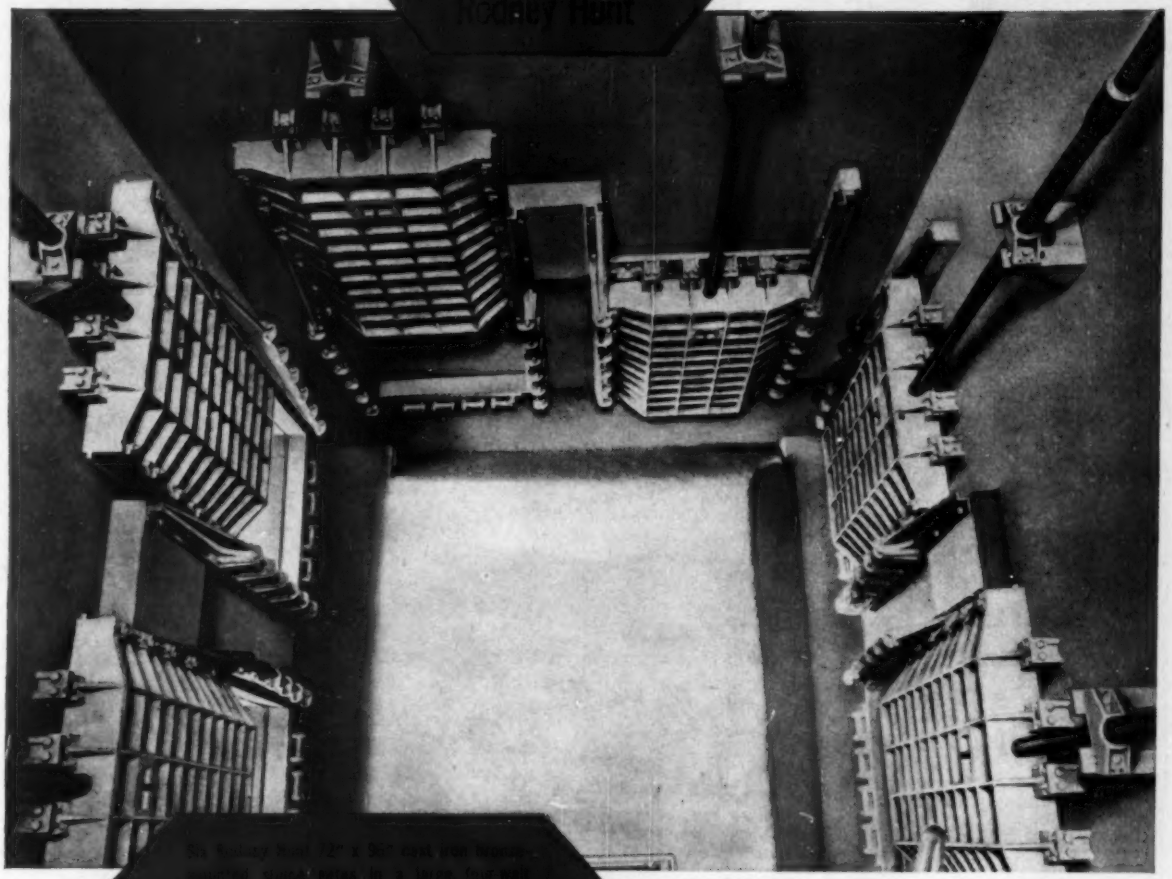

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Think how important it was on this huge project to be sure of proved design, dependable operation and long life, *always* engineered into Rodney Hunt equipment. In addition to units shown, other Rodney Hunt sluice gates as big as 8′ x 8′ clear opening were installed in this underground reservoir and filter plant built for one of our greatest cities.

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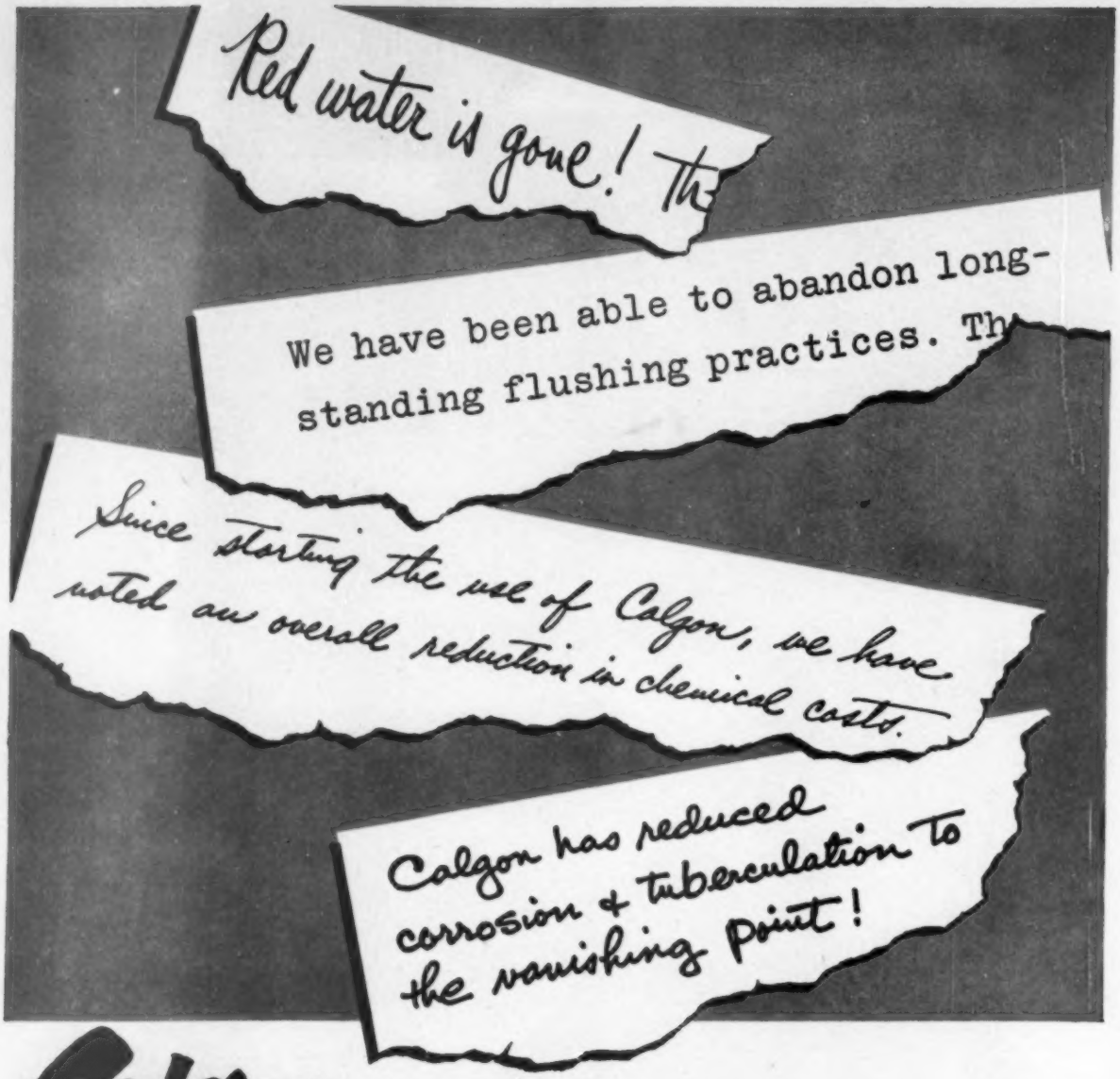
Red water is gone! Th
We have been able to abandon long-
standing flushing practices. Th
Since starting the use of Calgon, we have
noted an overall reduction in chemical costs.
Calgon has reduced
corrosion & tuberculation to
the vanishing point!

Calgon* cures water problems...saves money

These are a few of the comments made by water departments from coast to coast after initiating the use of Calgon.

The remarkable properties of Calgon make its use a simple and economical method of controlling corrosion,† reducing tuberculation and eliminating discolored water in municipal and industrial systems.

The accumulated experience of years of service to water departments all over the country is at your disposal. Write or phone for help with your particular problem.

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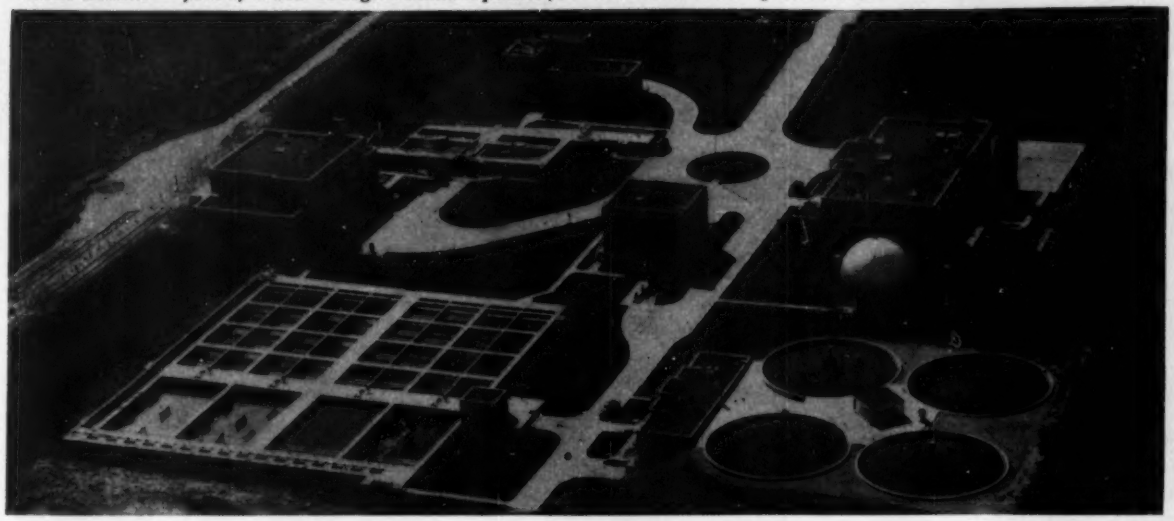
†Fully licensed for use under U.S. Patent 2,337,856.

"Little Miami"—first of 4 new sewage treatment plants for Cincinnati's metropolitan area



Cincinnati leads Ohio River clean-up program

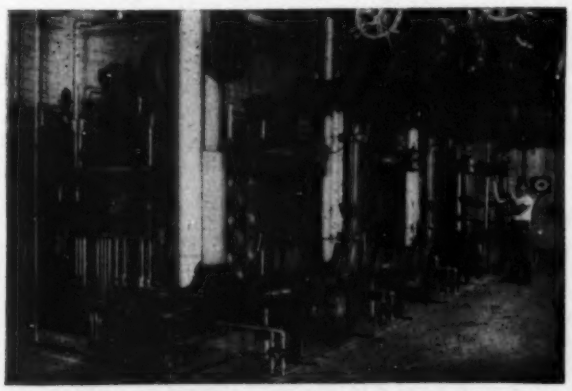
Four-plant, 154 MGD project includes PFT "Controlled Digestion"

Leading an 8-state drive for modern sewage disposal in the Ohio River Valley, Cincinnati recently completed the first of 4 sewage treatment plants to serve the entire metropolitan area. Their splendid new system has encouraged other Ohio River municipalities in this great clean-up program!

Called "Little Miami," the new 29 MGD plant adopted the following items for PFT "Controlled Digestion":

(1) *PFT Floating Covers* in the four 65′ digesters for positive scum submergence, safe utilization of gas and simplified operation.

(2) Four *PFT Cover Position Indicators* to record the liquid level in each digester.



Four No. 750 PFT Heater & Heat Exchanger Units.

(3) Four *PFT Supernatant Selectors* for automatic, continuous withdrawal of the best digester liquor, along with *PFT Gauge, Sight-Glass and Sampler* units.

(4) Four *PFT No. 750 Heater & Heat Exchanger* units to keep digesters at optimum temperatures of 90°-95° F. Fired by sludge gas *or* oil, these units cut fuel costs by utilizing all sludge gas available, automatically changing to oil as necessary. In addition to sludge heating, these units provide heat for the digester control building.

Little Miami will be followed by the 120 MGD Mill Creek plant, the largest of the group. PFT has already received extensive orders for "Controlled Digestion" equipment in the huge new plant including 12 PFT 110′ diameter Floating Covers with PFT Aluminum Prefabricated Roof Decks, and PFT Pearth Gas Recirculation Equipment and 23 PFT External Heat Exchanger Units.

Design of plants by / *Havens & Emerson, Consulting Engineers, Cleveland, Ohio*

P.F.T.

waste treatment equipment exclusively since 1893

PACIFIC FLUSH TANK CO.

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10,000,000 METERS

These are the parts for a new ⅝" Trident water meter. They embody every proved advancement in design and materials known to modern meter manufacture.

Most important: These modern parts fit any of 10,000,000 Trident meters built since 1898, except for a few differences between some parts in frost-proof and split-case meters.

In your meter shop today you can replace worn parts in any old Trident meter with these modern Trident parts. At only a fraction of the cost of a new meter, you get a thoroughly up-to-date meter ready for many more years of accurate service.

No need to stock parts for many models . . . just order the latest parts. Your training problems are eased . . . your repair men need learn only one meter. And you need never scrap a Trident because it is a "discontinued" model.

This 50-year policy of Neptune's is your best assurance that the meters you buy today will earn maximum revenue for your utility . . . with lowest yearly costs . . . for many years to come.

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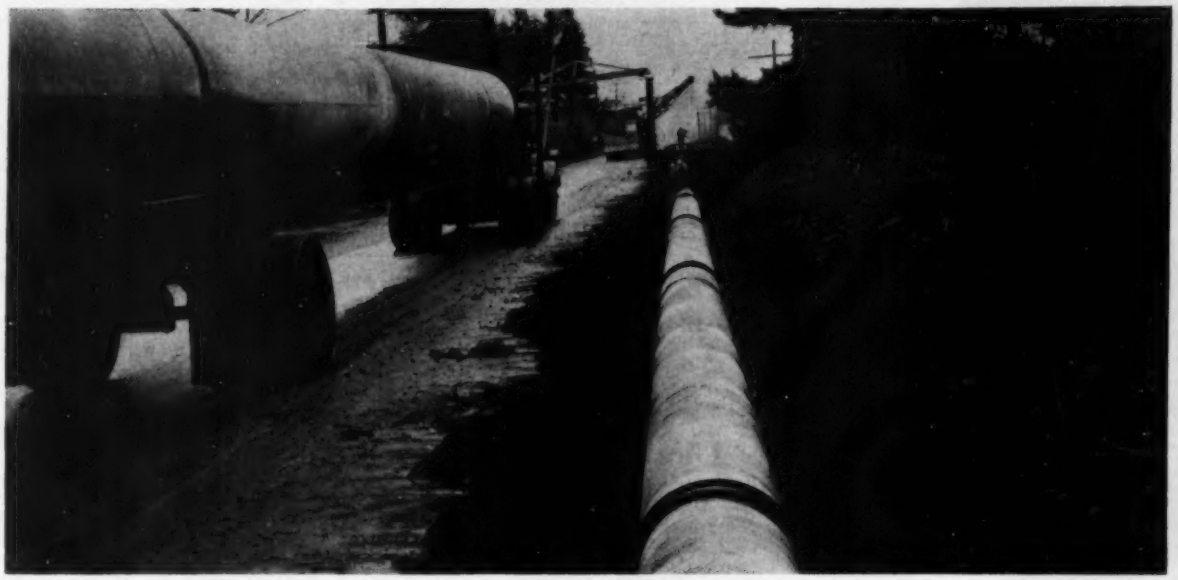
256

WATER & SEWAGE WORKS

VOL. 101, NO. 9 • A Scranton Gillette Publication • SEPTEMBER 1954



BULL RUN 100 mgd Conduit No. 4—Alongside is 70 ft from city to headworks on Bull Run.

Portland Adds Another Supply Line

To keep the verdant "City of Roses" and lush lawns free of possible water supply shortage

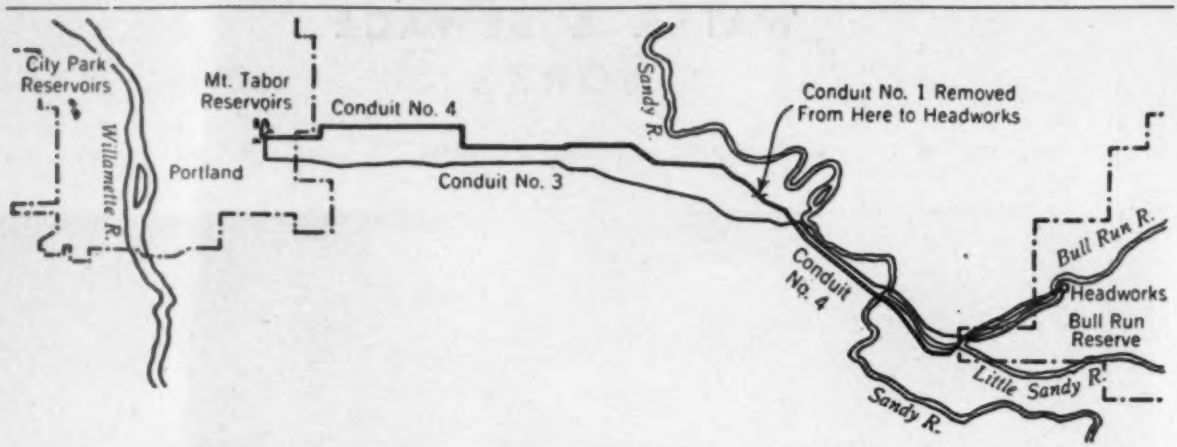
by **BEN S. MORROW** *(Hon. M.-A.W.W.A.) Chief Engr. & Mgr. Bureau of Water, Portland, Oregon*

PORTLAND, Ore., incorporated in 1851, has enjoyed a century of rather steady growth and now has an estimated population of 405,000. It is largely a city of privately owned homes with well kept lawns and gardens, famed for their roses. In 1857 the first public water supply for the city was constructed by two enterprising citizens who installed a wooden pipeline from Caruthers Creek, located about a mile south of what was then the center of town. For the next few years various creeks and wells were added to the system until, in 1868, the Willamette River became the main source of supply, the water being pumped at a station located a very short distance from the southern edge of the city.

During low summer flow the Willamette River at Portland is affected by tidal action. Such sewers as had been built discharged into the river, and tidal action rendered the quality of the water at the pumping station very questionable to say the least. In 1884 the water company built a new pumping station about 5 miles upstream and installed steam-operated pumps with a combined capacity of 16 mgd.

In 1885 the state legislature amended the city charter to authorize Portland to construct or purchase a water system sufficient to furnish its residents "an abundant supply of good, pure water." An engineering study resulted in recommendations for the purchase of certain water rights on the Bull Run River, the construction of a steel pipeline from the Bull Run at a point about 30 miles east of the city, and

Ed. Note: This paper was presented before the Seattle Convention of the Am. Water Works Ass'n. by Mr. Morrow May 26, '54. It is here printed by prior arrangement and permission of the Association.



ROUTE of the four conduits, 30 miles. length of 56 in. steel pipe on specially-designed trailer.

the building of four distribution reservoirs—two at Mount Tabor and two in City Park—with a combined capacity of 65 mil gal. The water company's facilities were purchased, and the river pumping plant was operated by the city until the completion of the Bull Run line in 1895, the delay being due to the governor's two vetoes of legislation authorizing the issuance of bonds.

The Bull Run River above the diversion for the Portland supply lies almost entirely within a federal forest reserve established in 1892. The watershed, an area of 102 sq miles, is on the west slope of the Cascade Mountains, and the river, with an average runoff of 500 mgd, has its source in innumerable springs, small creeks, and lakes fed by melting snows and rainfall, which is very heavy in this region. Annual precipitation in the city averages about 43 in., while, at the headworks only 30 miles to the east, it is 70 in.; at Bull Run Lake, which is located at the eastern end of the watershed at el 3,160, rainfall averages 144 in. a year.

Bull Run Conduits

(see drawing)

Conduit No. 1, completed on Jan. 1, 1895, was designed to carry 25 mgd. It consisted of 24 miles of asphalt-coated, riveted steel pipe varying in diameter from 33 to 42 in. Maintenance on this line, which was in service 58 years until the fall of 1953, increased steadily in the past few years, owing to pitting of the steel pipe from the *exterior* rather than from the interior. This attests the favorable quality of Portland's water supply.

To meet rising demands for water, Conduit No. 2 was installed in 1911, generally along the same right of way as the first line. The second steel pipeline, of lock-bar construction and 44-52 in. diameter, had a capacity of 50 mgd and, with Conduit No. 1, provided an adequate supply until 1924. At that time a third steel conduit, 50 and 58 in. in diameter, was laid, to bring in another 75 mgd.

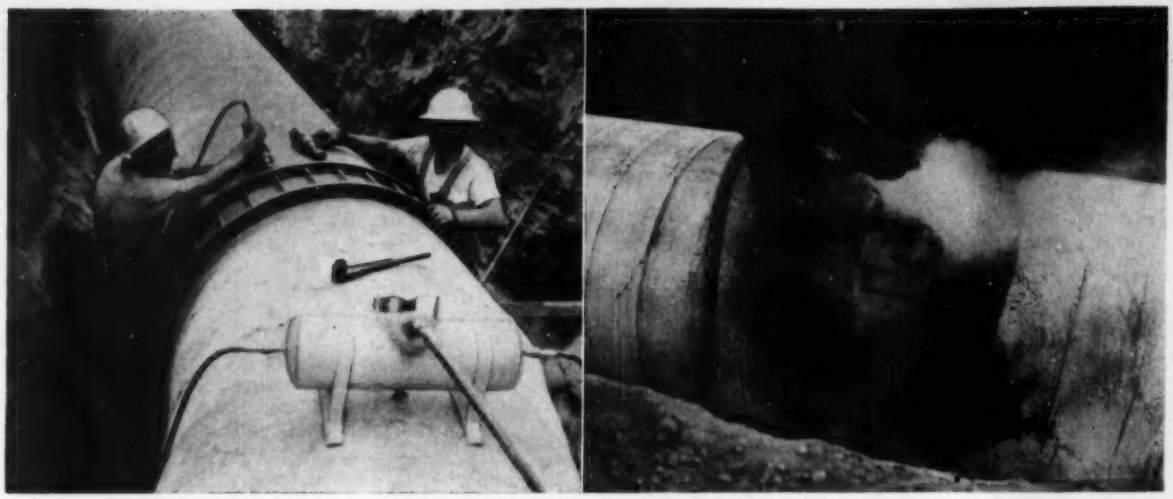
By 1950 the population of Portland had passed 370,000. The growth of the city, together with the development of suburban areas that had organized 55 Water Districts or Companies supplying 120,000 people, were beginning to tax the capacity of the three conduits during the summer. In the past the maximum-day demand was approximately twice the daily average, with the peak hourly rate about double that average on the maximum day. Because of the rapidly increasing use of lawn-sprinkling systems, the old rule is no longer applicable. At present the peak day's demand is two and one-half times the average, and the peak hourly rate is twice the maximum-day average.

In view of the increased demand and the age, small capacity, and heavy maintenance requirements of Conduit No. 1, it was decided to replace it with a new line to carry 100 mgd. Plans called for the installation of 10 miles of 66-in. steel pipe, with a plate thickness of ⅜ to ½ in., and 15 miles of 56-in. pipe ⅝ in. thick.

Terrain conditions in the area where the 66-in. portion of the line was to be located made it advisable to remove about 5 miles of Conduit No. 1 and install the new line in its place. As the old conduit had to be kept in service during the summer to meet the heavy demand, the installation of part of the new line had to be delayed. The major portion of the 56-in. section of the line is located along country roads and has been well separated from the other existing conduits, to help assure continuity of service in the event of bombing or other disaster in the area. With only minor deviations, specifications for the new line followed AWWA standards *(1)*. A bid of $4,975,000 approximately $275,000 less than the engineers' estimate, was accepted in April 1952.

SHOP COATING pipe with Barrett coal-tar enamel.

Note weld joint bells for converting 35 ft. lengths into 70 ft. sections.



DRESSER COUPLINGS—Taking up bolts with electric torque wrenches. And, contractor's improved (patented) method of pressure spray coating of couplings and bolts.

Fabrication and Coating

The contractor decided to fabricate the pipe in 69'-10½" lengths and to use mechanical couplings for the field joints. A subcontractor manufactured each pipe length from two 35-ft. "cans" composed of two half-sections requiring only two longitudinal welds to the can. An 1½ in. deep bell was rolled in one end of a can, and, after coating and testing, a second can was inserted and the girth seam welded inside and out. This joint was shop tested by air under 40-psi pressure introduced between the interior and exterior welds, with soap suds indicating any defects in the welding. This method proved very successful in locating leaks, and no trouble was experienced in such joints when the line was subjected to hydrostatic tests.

After the pipe had been thoroughly cleaned by shot blasting and had passed through a heating oven, it was given a priming coat and the coal-tar enamel coating was spun on. The exterior surface at the ends of each pipe length was left bare for a distance of about 8 in. (see shop coating picture), because mechanical couplings were to be used for the field joints, except for approximately 3,500 ft. of 66-in. pipe in Sandy River Canyon. This pipe was belled and the field joints were welded. A bonded,

TRACKSON PIPE LAYER, with 5-ton counter balance, 36 ft. spreader bar, two rubber belt slings.

coal-tar saturated, asbestos-felt wrap and a white-wash coating were applied to the pipe. Testing, cleaning, blasting and coating were performed in accordance with AWWA standards *(2)*. The coated pipe was carefully checked electrically for holidays in the coating, both inside and out, and the percentage of flaws found and repaired was very low.

Angle specials required for changes in alignment or grade were made from segments of tested pipe, the center radius of the bends being four times the pipe diameter and no segment making more than a 15-deg. angle. Each angle-welded seam was covered by a butt strap 5 in. in width. The seams of the specials were air tested and were coated and wrapped by hand.

Laying of Pipe

Although trouble had been anticipated in hauling the almost 70 ft. long sections of pipe over city streets and county roads, none was encountered. The pipe was delivered to the job on specially designed semitrailers *(see No. 1 picture)*.

Practically all of the trench excavation was done with back-hoe shovels with 1½-yd. buckets. In the Sandy River Canyon section, however, where grades as high as 76 per cent occur, the trench was dug with a drag line. Bell holes were usually dug with the back-hoe as the trench excavation was made, but, in some parts of the line, a truck-mounted crane equipped with a clamshell bucket was used for this purpose. The trench bottom was finely graded by hand just in advance of pipe laying. In sections where rock was found, bedding sand was used.

The pipe was laid down by side-boom caterpillar tractors with 5-ton adjustable counterbalances. A spreader bar, 36 ft. long, was used to place the pipe in the trench, the pipe being picked up with two 18-in. rubber belting slings *(see No. 4 picture)*. The maximum footage of line laid in one day was 1,540 ft. (56-in. diameter pipe).

Couplings

The mechanical couplings used on approximately 98 per cent of the line *(see pictures 5 and 6)* had 7/16 in. thick T-bar followers, with the middle rings 10 in. long and of the same thickness as the pipe. Steel track head ¾ in. bolts, with upset rolled threads, were employed—36 bolts for the 66-in. pipe couplings and 32 for the 56-in. The couplings were primed at the factory.

Improved Method of Coupling Coating

The coal-tar enamel coating of the couplings was applied by spray equipment designed and patented by the coating contractor. It consisted of a trailer-mounted rectangular tank of about 3,000-lb. capacity, a burner and two butane tanks for heating the tar enamel, an agitator with a 5-hp motor, a pressure pump with a 7.5-hp motor, and an automatic heat regulator. A 30-ft. flexible metal hose carried the tar enamel to the spray gun. Electricity for the spray machine was furnished by a 440-V A-C diesel driven generator mounted on the tow truck. The metal hose was heated electrically to about 300°F to keep the enamel from cooling. The enamel in the machine was heated to about 475°F. This system of spraying the enamel on the coupling was a great improvement over the methods used on former jobs.

As the pipe was laid, it was backfilled between holes with selected material tamped or water settled to a point above the spring line. Hydrostatic field tests—50 psi above the maximum working pressure and never less than 125 psi—were made, usually on sections 5,000 ft. or less in length. Relatively little trouble was experienced.

Although the contract, awarded on Apr. 8, 1952, had a completion date of June 1, 1953, delays, due in part to the steel strike in 1952, the line was not completed until Dec. 18, 1953, at which time it was put in service.

References

1. Standard Specifications for Electric Fusion Welded Steel Water Pipe of Sizes 30 Inches and Over—AWWA C201. Am. Wtr. Wks. Assn., New York (1950).
2. Standard Specifications for Coal-Tar Enamel Protective Coatings for Steel Water Pipe of Sizes 30 Inches and Over—AWWA C203. Am. Wtr. Wks. Assn., New York (1951).

W&SW

W. C. Purdy, Pioneer Biological Expert, is Dead

W. C. Purdy, pioneer biological expert and investigator in the field of stream pollution, died July 15. He was 83 years old.

After an early career in which he taught biology at the Pennsylvania State Teachers College and Geneva College of Pennsylvania, he became associated with the U. S. Public Health Service in 1913 as a special expert in aquatic biology. He was one of the small group of pioneering scientists who initiated the work which led ultimately to the establishment of the recently dedicated Robert A. Taft Sanitary Engineering Center at Cincinnati, Ohio.

Mr. Purdy is noted for his pioneering investigations in the microbiology of stream pollution and water purification. His studies of algae and stream plankton are particularly well known and still form the basis of much of our current knowledge of these subjects. Mr. Purdy made a special study of the role of tubificid worms in the recovery of polluted streams. These are worms that work with their heads buried in the ooze on the bottom of polluted streams and breathe through their tails, which extend up into the flowing water over the ooze.

A nationally recognized biologist in the field of stream pollution investigations, Mr. Purdy's studies of the Ohio, Illinois, Potomac, and Scioto rivers are still notable reference works, and the pattern of investigation and the principal features of stream biology as elucidated by him remain today as landmarks of progress in sanitary science.

Mr. Purdy has made his home in Cincinnati since 1913. After 28 years of service with the Public Health Service he retired in 1941, but continued his investigative studies of the biology of polluted streams.

Mr. Purdy is survived by two daughters, Mrs. Margaret Kier of Pittsburgh, Pa., and Mrs. Katherine Calvert, of Charlotte, N. C.

Hydraulic Research in U. S. Publication Available

"Hydraulic Research in the United States 1954," is the title of a new National Bureau of Standards Miscellaneous Publication 210.

This publication contains information compiled from reports by the various hydraulic and hydrologic laboratories in the United States and Canada. Reported projects include private, university, and government supported research. A large number of the projects listed in this volume are reported for the first time.

Projects are reported by title and carry a number which is kept throughout the project history. Other information includes the project sponsor, project correspondent, the nature of the project, a brief description, the present status, results and publications.

Copies of this 193-page booklet may be ordered ($1.25 per copy) from the Government Printing Office, Washington 25, D. C.

Operation of Small Waterworks

Equipment and Materials

by **A. E. CLARK,** *Manager, Suburban Utility District, Nashville, Tenn.*

USE OF the term equipment refers to the various tools, transportation, trenching and backfilling equipment, pumps, lights, etc., which are normally used in the operation and maintenance of small water works. The term material refers to items used in new construction, maintenance, etc. Good operation and maintenance requires a certain amount of equipment of the type which will provide the means for properly handling a job.

Much time and waste of funds can (and does) result from the lack of proper tools and equipment. Some of the small water utilities for various reasons try to operate without the proper or necessary tools and equipment. This may be due to lack of funds or lack of knowledge. Some small water utilities have maintenance work done by an outside concern. Whether this is good practice depends of course on local conditions; however, an experienced man is usually able to do this work at a considerable saving over having it done by an outside company or individual. Some have the idea that proper equipment costs too much and that the water utility cannot afford it. This idea is usually wrong and can be proved so if the original cost and expected life of tools and equipment is figured and the cost is spread over the useful life of such.

Doing It the Hard Way

Too many times maintenance and repair work by small water works is done the hard way, due entirely to the lack of the proper tools or equipment. The same reasoning can apply to new work, such as meter services, new mains, setting fire hydrants, installing valves, etc. As an example, the experience of a water utility in the matter of meter services and meter settings will be cited. Meter services using ¾″ galvanized pipe fo: standard connections was used, installing a ¾″ corporation stop and using a lead goose neck. The meter box was constructed of brick laid up in mortar and an oblong cast iron meter box frame and cover used. The ¾″ galvanized pipe was run to the box, a ¾″ curb stop installed followed by a galvanized ¾″ by ½″ reducer then the meter coupling. The meter and a coupling on the outlet spud of the meter was left for the plumber to connect to the service line to the residence. The first change consisted in replacing the galvanized pipe with copper tubing, using flared joints. This did away with the use of pipe cutters and stock and dies as well as the need for a vise. The only equipment used was the small copper pipe cutter, flaring tool and hammer, plus wrench for the reducer and meter couplings. The next change substituted ¾″ by ½″ curb stop in place of the ¾″ stop and reducer. Next came the use of copper setters and precast concrete meter boxes with round cast iron covers. The overall change was not so much a saving in material costs as it was in time and labor, not to overlook the better meter setting than formerly.

Slowness to Try the New

Too many times operation and maintenance procedures follow practices which were considered good fifty years ago. New developments are being made all the time usually making the work not only easier, but at a considerable saving in overall costs. It costs but little to subscribe to the various magazines and maintain membership in organizations devoted to water utility work. They cover everything from administration down the line. The manufacturers of water works equipment are constantly working on better equipment, tools, etc., to do better jobs. The exhibits at the annual conference of the A.W.W.A., the California and Southwest sections

GENERATOR and Flood Lights, Worth a Lot in Night Work.

PAYING Back-hoe and Bulldozer Combination on Rubber Wheeled Tractor.

and the New England W.W.A. provide members and visitors a means of seeing the new developments as well as the opportunity of discussing them with the manufacturer. Many of the utility men attending have already used some of this newer equipment or materials and are in a position to provide practical information regarding its use. Too many water works men are prone to continue use of obsolete equipment, working under the erroneous assumption that it is still the best and without studying in detail the benefits that could be derived by the purchase of new equipment or adopting new methods.

Mechanical Joint Fittings

Take for example, mechanical joint pipe and fittings which are coming into more general use. Some systems have old 2″ and 3″ galvanized pipe in service. Suppose it is necessary to repair a break. Most utility operators know what it means to complete the repairs by installing a 2″ or 3″ union. Unless everything lines up almost exactly right a great deal of time is lost connecting the union. To those who are still doing this, I say try one of the mechanical joint types of sleeves. You will find it amazing the time, the fuss and bother, and cussing that is saved. Mechanical joint split and solid sleeves not only effect a saving in labor but in the time required to repair the average main break. And, finally the utility operator is anxious to complete repairs as quickly as possible and get the water turned on again, especially if consumers are out of water. The same reasoning applies to the laying of mechanical joint pipe for replacements, or extensions.

What About That Night Work?

In the cast of a main break, particularly at night (it seems that the majority of them occur then), what provision is made for light to enable the men to repair the break. Small generating units are on the market which are remarkably efficient. These units are driven by gasoline engines. Some type of flood light for 100 or 150 watt lamps are very satisfactory. They can be mounted on standards made at the water utility shop, either the same or different heights. A ditch pump to take care of the water when repairing a main break is a necessity. It should be ruggedly built and have a capacity of 150-250 g.p.m. The primary criticism in the use of the above light and pumping equipment is maintenance. The manufacturer furnishes complete instructions for the successful use of the equipment and if the instructions are followed little trouble is usually encountered. However, some utility operators seem to think that proper maintenance is not required and are surprised when the equipment fails to operate properly. Very little money is expended on either of the above pieces of equipment if they are given proper maintenance. If some mechanical trouble should develop, even though it appears minor, it should be repaired immediately. The minor troubles are the cause of major troubles if not corrected. This equipment must be kept in condition to operate at all times.

Transportation Equipment

Transportation equipment should be suitable for the job. Obviously, if loads aggregating a ton or more are to be transported, a ½-ton pick-up truck is not satisfactory for this work. It eventually will cost more in maintenance than the additional cost of a higher capacity truck which will accommodate the loads. Some provision should be made for carrying tools, etc., in each truck. Special bodies can be purchased with bins, etc., for carrying tools and equipment or they can sometimes be fabricated and installed locally to meet certain specifications.

Tools and material should be carried in each truck and checked periodically to see that none have been lost or misplaced. Tools and equipment should consist of wrenches, bars, curbstops, corporation cocks, gaskets, washers, etc.; in other words, the proper tools and material to do practically any commonplace or routine job without having to make a trip back to the shop for a wrench or piece of material.

Trenching and Earth-moving Equipment

Many of the smaller water utilities hesitate to purchase mechanical trenching and backfilling equipment due to what is considered a high first cost, however, a cost study of actual expense of installing new mains, etc., by the use of trenching equipment as against hand labor may present some interesting figures. Another case can be cited of a water utility which used all hand labor and changed to mechanical equipment. The area in which the utility operated contains considerable rock. That meant that, in general, an ordinary trencher would not be economical; so, an investigation was made to find out if a backhoe was made in the size that could be used economically. One such was found. It has the advantage of being mounted on rubber so that it is self propelled and does not require the use of a low boy for transporting it to the different jobs. This equipment (see picture) is mounted on a tractor and consists of a backhoe and blade for backfilling or bulldozing. The buckets are interchangeable and a 12″ or 24″ bucket is used depending on the job. When trenching in rock this equipment has the advantage of being able to remove the rock after shooting. It has proved very satisfactory, saving both time and labor on the average job. The same equipment using the smaller bucket is used in excavating for new meter connections and has proved very beneficial and time saving in excavating for main breaks.

Inventory of Repair Materials

The question of the kind and amount of repair material to be carried in stock depends to a certain extent on local conditions. Repair sleeves, both split and solid should be

carried for every different size main or pipe in the system. These can be either mechanical or B & S, depending on which is preferable. Pipe of every size in the system should be in stock if for nothing more than emergency use. This also can be either mechanical joint or B & S. Spare valves for each size of main are useful to have ready for installation. Spare parts for fire hydrants are a necessity.

Any number of items could be mentioned that would be helpful if in stock at the time some particular emergency arose. The items carried depend on the system also. If there is a main pumping station and water purification plant then other material must be carried for repair and replacement service. Particular attention should be given to this phase since the lack of one repair or replacement part could be of a serious nature. The manufacturers or dealers are very helpful in recommending the repair or replacement material that should be carried in stock. The quantity to be stocked also depends on local conditions. If repair parts are carried by local dealers this will obviate the necessity of maintaining a large inventory.

Equipment of the proper type should be a part of the set up, such as tapping machines, melting furnace for lead and/or sulfur cement jointing material, pipe cutters of proper sizes for the mains in the distribution system, wrenches including socket wrenches of the type and size required for the various jobs, stocks and dies for the various size pipe if used in the system, bars, hammers, etc. In general, complete equipment for doing whatever type of job may materialize aside from specialized work usually not done by a small water utility, which would require the services of a factory representative or some one with similar training.

Purchasing Practices

Purchasing material and equipment deserves considerable thought. Too many instances have shown that buying at the lowest price in competitive bidding has not always proved to be the most economical in the long run. At times the low bid material or equipment may not be as suitable for the jobs to be performed. Standardization in materials, particularly, is one important factor to always consider when restocking currently used material. This has many advantages providing the material purchased is the best for the use to which it is to be put. Low first cost appeals to many; but, like any commodity purchased, what is its expected life and what maintenance costs can be expected during its useful life. Purchasing only for the present is not good practice. It will cost the utility or taxpayers more in the long run.

Equipment should receive just as much consideration as materials. There are a number of factors to be studied. Some of these are: will the equipment do the job or jobs; what can be expected in the way of maintenance; what is its expected useful life; what experience have others had with the equipment; is it something new which has not been in use long enough to determine its uses and life; if so, is the manufacturer well established enough to stand behind it, etc.

Instead of purchasing on the basis of low bid or price on materials or equipment, purchases should be based on the lowest *or* "best" bid or price, which does not mean that the lowest bid or price is the best in every case. It is also important that specifications be carefully prepared for two reasons, 1) those bidding on the equipment or material must meet the specifications, 2) anyone bidding and meeting the specifications will be obliged to furnish the material or equipment desired.

The satisfactory operation of a water utility, large or small, depends on being able to maintain and service the entire system in a business and workmanlike manner without undue delays due to lack of materials, equipment or know-how.

W&SW

SERVICE and Repair Truck.

Leo Louis New V.P. and Gen. Mgr. Gary-Hobart Water Corp.

Leo Louis, Jr., has resigned his position as superintendent of water works at Cedar Rapids, Ia., to accept appointment as vice-president and general manager of the Gary-Hobart Water Corporation at Gary, Ind. He succeeds the late "Ted" Rudgal who died very suddenly after a heart attack.

Third Volume of Abstracts On Corrosion Published

A 346-page book containing 3512 abstracts of articles and books on corrosion has been published and is now available from the National Association of Corrosion Engineers, 1061 M & M Building, Houston 2, Texas. The articles are from more than 500 periodicals published all over the world and are abstracted by some 30 agencies that authorize NACE to use their abstracts.

This third volume of abstracts published by NACE contains summaries of articles and books published in 1948-49, topically indexed and cross-indexed and with both alphabetical subject and author indexes.

1954 A.W.W.A. Seattle Conference

3-Report of Technical Sessions

Presiding officers at the General Session of the Water Resources Division were: Chairman, M. B. Cunningham; Co-chairman, Fred Merryfield; and Assoc. presiding officer, C. H. Bechert.

Water Resources Division Sessions*

The session opened with a motion picture "THE NEW PAUL BUNYAN" presented by Weyerhauser Timber Co. This illustrated current practices of forest management, modern logging and sawmill operations, and the latest manufacturing processes which result in the fullest utilization of available timber.

"WATERSHED AND RESERVOIR CONTROL IN THE NORTHWEST—OWNERSHIP, LOGGING PRACTICES, AND POLICING" — a panel discussion — was presided over by Moderator ROY W. MORSE, Supt. Water Dept., Seattle, Washington.

Panel Members and Their Sub-Topics:

GEORGE A. MARSHALL, Chief Clerk, Portland Water Dept., Portland, Oregon—"BRIEF HISTORY OF PROJECTS."

W. A. KUNIGK, Supt. Water Dept., Dept. of Public Utilities, Tacoma, Washington — "OWNERSHIP AND MANAGEMENT."

ALLEN E. THOMPSON, Forester, Seattle Water Dept., Cedar Falls, Washington—"FORESTRY AND LOGGING OPERATIONS."

CHARLES C. CASAD, Supt. Water Dept., Bremerton, Washington — "CONTROL OF ALGAE AND WEED GROWTH."

ROBERT A. DUFF, Supt. Water Com., Medford, Oregon—"GENERAL SANITARY PROTECTION AND POLICING."

T. V. BERRY, Greater Vancouver Water Dist., Office of Administration Board, Vancouver, B. C.—"RECREATIONAL USE."

Members of the panel discussed the water supplies of six of the larger cities in the Pacific Northwest; Bremerton, Seattle, and Tacoma in Washington; Medford and Portland in Oregon; and Vancouver in British Columbia. A digest of most of the material presented by all speakers on the panel has been arranged under the name of the city to which it applies.

It was pointed out that the mountains in this area are generally steep and rocky with deep canyons and valleys. Adequate storage is needed to care for seasonal demands for water.

Bremerton, Portland, Seattle, and Vancouver, with unlined storage reservoirs, use copper sulphate for algae control. This is largely applied by dragging sacks of crystals behind a motorboat. All sources are patrolled regularly and algae growths treated promptly.

All six cities either control or prohibit habitation on the watershed areas.

Bremerton, Washington

In the four watersheds supplying the city, about 6500 acres of the total of 9500 are owned by the city; 11 per cent are owned by the State, and the balance by mill and timber companies and miscellaneous owners. Several wells were developed during World War II. Fifteen mgd constitute the available supply.

Since 1950 the city-owned forest areas have been managed on a long range, sustained yield forest management plan through a contract with a firm of foresters and timber operators. City employees patrol the watershed area daily, using four-wheel drive jeeps. These employees are deputized by the sheriff. The area is closed to hunting and fishing so that the State Game Department assists in patrolling.

The water supply is treated with ammonia and chlorine at the Anderson and Gorst Creek pump stations, and at the main 11 mg reservoir. Chlorine only is used in the gravity line from Union River.

Seattle, Washington

Since 1901 all water has been obtained by gravity from Cedar River and Cedar Lake. Two-thirds of the Cedar Lake watershed is owned by the city, 20 per cent is National Forest, and the balance belongs to private owners.

Lake Youngs provides 366 mg storage. Four pipelines to the city have a capacity of 205 mgd. Ten reservoirs, 9 standpipes and 5 tanks in the city provide about 360 mg storage.

The water department has its own forester and forest management program. Logging operations are conducted by the Cedar River Logging Agreement, a contract with three private timber companies owning land in the watershed area, by which one operator does all logging.

With unlined storage reservoirs, weed growths are controlled by application of copper sulphate along shore lines and use of flame torch. Fern growths three to four feet under water are controlled by lowering the lake level and exposing the growths for several weeks until killed.

The responsibility for sanitary protection rests in office of the Sanitary Engineer of the Seattle Water Department. Four sanitary patrolmen are housed at strategic points on the watershed to police logging operations, power production, railroad, and other uses of the area. Work parties use chemical toilets. Toilets on all passenger trains are locked while passing through the watershed. Ammonia chlorine treatment is used at the control works below Lake Youngs with supplementary sodium hypochloride treatment at several reservoir outlets in the city. Twenty weekly samples of water from the Cedar River and tributary streams are checked for B. Coli.

No recreational use of the watershed areas in any form is permitted.

Tacoma, Washington

Ninety-five per cent of the city's water supply is obtained by gravity from the Green River watershed. A 42-mile conduit brings the water to

*These sessions were reported by Edward R. Stapley, Dean, Oklahoma Inst. of Technology, A. & M. College, Stillwater, Okla.

the city from the 231 sq. mile watershed area. The balance of the city supply is obtained from the South Tacoma well system.

About one-third of the Green River watershed is owned by the U. S. Government, about three per cent by the cities of Tacoma and Seattle, and the remainder by the Northern Pacific Railroad, timber and manufacturing companies, and small owners.

The various logging procedures practiced on the watershed are outlined in a Manual of Watershed Rules and Regulations published by the Water Division of the city. Since 1950 the city has made extensive sediment and turbidity surveys in cooperation with the U. S. Geological Survey to reduce erosion on the watershed and changes in runoff characteristics due to logging operations.

Tacoma with its lined storage reservoirs has no weed problem, but chlorine and copper sulphate are used to combat algae growths.

It has been found that good runoff characteristics go hand in hand with good forestry practice. The lands of large landowners are policed daily. Additional police power above that granted by the State Health Department and City Ordinances is obtained by police power agreements made with the majority of the landowners on the watershed. In return, the city assists in recording timber growth and in engineering problems involved in road, bridge and drainage construction.

Portland Supply
Ben S. Morrow

Steel Pipe
Julien Hinds
G. R. Scott

Pipeline Crossings
W. V. Weir
M .P. Hatcher
E. A. Schmitt

Wood Stove Pipe
J. W. Cunningham

Water Valves
Leslie Paul

Cavitation
W. A. Kunigk

Medford, Oregon

The water supply comes from a series of springs about 30 miles northeast of the city and near the summit of the Cascade range. No surface streams exist. Water from winter snows and rains percolating through lava and emerging as springs is collected in concrete galleries. Two welded steel pipelines, one of 11 mgd capacity built in 1913, and the other of 13 mgd built in 1951, bring the water to the city.

About one-eighth of the watershed area is owned by the city, 85 per cent by the U. S. Government, and the remainder by private interests.

The watershed forests are managed by the U. S. Forest Service which operates on a ten year plan of timber sales, planting, and tree pruning.

Lined reservoirs eliminate weed problems, but the reservoirs are treated weekly with copper sulphate and brushed down with stiff fiber brooms.

The U. S. Forest Service, through its ranger patrols, cooperates in maintaining sanitary standards on the catchment area. City pipeline patrolmen and caretakers at intake maintain a close check on sanitation. Hunters and fishermen use the area without restriction. No adverse effects have been noted in the water from the springs as a result of this unrestricted use of the area.

Portland, Oregon

The city is served by a gravity supply from the Bull Run River watershed. An area of 218 square miles was created by Act of Congress, April 28, 1904, as a Reserve on which public entry, settlement, and grazing of stock was prohibited. State Laws and City Ordinances also control trespass on the area. About 95 per cent of the 102 square miles in the watershed of the city's supply is owned by the U. S. Government and less than 5 per cent by the city itself.

A concrete gravity dam provides 11 billion gallons of storage. Three steel conduits (52 in., 58 in., and 66 in.) carry the water from a gravity diversion dam five miles downstream from the storage reservoir to the city. These conduits have a total capacity of 225 mgd.

About 54,000 acres of the watershed area of the city is heavily forested. No logging operations have been conducted nor are they contemplated. The cost of fire protection is financed by the city and the U. S. Forest Service.

Attendants are on duty at distribution reservoirs at all times. Daily water tests are made by City Health Department of water from reservoirs and various points on distribution system. Careful records are kept of results of these tests.

Vancouver, B. C.

Greater Vancouver consists of four cities, ten municipalities, university lands and the Connaught Headquarters Water District. The total population served is about 600,000.

The water supply comes from three sources: the Capilano, Seymour, and Coquitlam Rivers. The total catchment area of 226 square miles is held by the Greater Vancouver Water District or under a 999 year lease from the Provincial Government.

A survey and appraisal of forest resources of the watersheds is now being undertaken by a firm of forest management engineers to determine the economic feasibility and appropriateness of limited removal of mature timber.

Regulations of the Provincial Board of Health require periodic health tests of all employees. All others are pro-

hibited from entering catchment areas. Roads are closed by guarded barriers. Watershed perimeters are patrolled where frequented by skiers or mountaineers. All employees are constables. Open reservoirs are fenced. Fishermen are allowed to fish in streams below intakes on presentation of permits. The roof of the closed storage reservoir is used for bowling and tennis.

Future Plans of Seattle

"SEATTLE'S PLANS FOR THE FUTURE" were outlined by MAYOR ALLEN POMEROY, who suggested also that his talk might be given the title "From Ski Level to Sea Level."

Two years ago this city, named after Chief Seattle, celebrated its one-hundredth anniversary. From populations of 3,000 in 1880, 90,000 in 1900, 237,000 in 1910, the city had grown phenomenally to an urban population in 1950 of 1,053,000—with an additional adjacent rural population of 370,000. Greater Seattle with its 600 square miles of area now has over one-half of the state's population. This large growth in recent years has brought many planning problems.

Under current activities of the city, the Mayor listed the planning of a new site for municipal government offices, a new zoning plan, surveys of the Cedar River watershed for new water and power possibilities, formation of the Puget Sound Planning Council and the Puget Sound Utility Council.

Future Water Resources

"THE PACIFIC NORTHWEST'S RESOURCES" by FRED MERRYFIELD, Professor of Sanitary Engineering, Oregon State College, Corvallis, Oregon.

In his outline of geographical and governmental changes which had occurred in the Northwest, Professor Merryfield used two large maps: one a U. S. Corps of Engineers map of the Columbia River Basin, and the other a U. S. Weather Bureau relief map of the U. S. showing contour and rainfall. Interesting sidelights on the early history of the Northwest were related. The many natural resources of the region were emphasized by Professor Merryfield, who noted particularly the marked increase in irrigation in recent years.

Second Resources Division

Presiding officers at the second session of the Water Resources Division were: Chairman, A. D. Henderson; Co-Chairman, B. S. Grant; and Assoc. presiding officer, A. S. G. Musgrave.

"WATER—FOUNTAIN OF LIFE" was the title of a motion picture shown by courtesy of the Byron Jackson Co. It emphasizes the many uses of water and its great importance to human life and in industrial progress, depicting the collection, purification, and distribution of water.

Radar and Rainfall

"THE RADAR MEASUREMENT OF RAINFALL"—In his presentation of this paper, DR. A. M. BUSWELL, Chief, State Water Survey, Urbana, Ill., stated that he was assisted in the preparation of the paper by Messrs. G. E. Stout and J. C. Neill of the State Water Survey.

Standard rain gages do not give a good estimate of a real rainfall, but merely measure the rainfall in the immediate vicinity of the collectors. Extreme variability of rainfall over small areas of 100 square miles or less, using rain gages spaced 1½ to 2 miles apart has been recorded. Several distinct rainfall centers may be noted in a single storm with rates of rainfall varying one-fourth inch in a distance of 1 mile. Such variations are particularly likely in storms of short duration.

Since 1948 the Illinois State Water Survey has been investigating the use of radar in measuring rainfall. By using this high frequency radio device, pulsations of definite wave length are sent out and the time and intensity of the return echo when a beam strikes an object such as an airplane or group of raindrops is measured. The time of return echo gives measure of distance to the raindrops while its intensity indicates the amount of rain.

A movie titled "Radar—Tomorrow's Raingage" illustrated the equipment and methods of its operation. The power of beams is increased and decreased automatically. Screens moved automatically, both vertically and horizontally, are used to pick up the return echoes. Pictures taken at definite intervals are shown against corresponding clock times.

With radar, Dr. Buswell pointed out, rainfall can be both located and measured, while a raingage can sample rainfall only if the storm passes over it. Comparisons of measurements of rainfall by radar with those by raingages indicate definite advantages in speed, cost, and accuracy for the radar equipment. The investigations are being continued.

Snow Surveys Predict Runoff

"THE VALUE OF WATER SUPPLY FORECASTS FROM SNOW SURVEYS" by FRED A. STRAUSS, Senior Hydraulic Engineer, Division of Water Resources, Sacramento, Calif.

Since there is practically no rainfall in California from June 1 to September 30, estimates of snow melts are important in predicting water runoffs.

The present program of snow surveys under the California Cooperate Snow Surveys involves Federal and State Agencies, with many municipalities, irrigation districts, power companies, and private land and canal companies. One hundred and fifty men are now employed with one-half of the annual cost of $60,000 being borne by the state and the balance by the other agencies. Measurements are made on 31 watersheds. Twenty-four years of accumulated data are now available to snow forecasters.

Reports of water conditions are issued during the early part of February, March, April, and May in each year. The reports give precipitation, surface reservoir storage, and stream flow, with forecasts of future runoff. Speed is essential in the publication of reports and predictions.

It has been found that a radio-active material, such as cobalt "60", may be placed in a cylinder on the ground with its impulses directed to a Geiger-Muller tube placed vertically above it. The impulses will be diminshed by the water content of the snow blanket. This equipment is very expensive but does enable automatic measurement data of snow packed water content to be transmitted to a central forecasting desk.

Runoff forecasts enable making planned programs of reservoir control for power generation. This value alone may more than balance the cost of snow surveys through the better scheduling of the operation of steam power plants. Other values of snow surveys were given by Mr. Strauss.

Controlling Weather

"WEATHER CONTROL PROGRESS" was reported by DR. IRVING P. KRICK, President, Water Resources Development Corporation, Weather Modification Projects, Denver, Colorado.

It was pointed out that we have no means of increasing moisture in the form of rain or snow from the skies when nature is unyielding. Only during the occurrence of actual storms can such operations be successful.

Currently most of the interest is in the increasing of precipitation by cloud seeding. The chief substance used for broad-scale cloud seeding is silver iodide, a yellow powder. By means of ground-based generators, this powder can be vaporized to form a myriad of tiny crystals which can be floated through the air to cloud

formations. It is estimated that one-sixtieth of an ounce of silver iodide, when vaporized at 2500° F, will produce about one million billion crystals, each one a potential nucleus for a raindrop when it ascends to responsive temperature levels.

Experience and data from past storms provide helpful information as to best locations for ground generators in relation to any particular set of storm conditions. Only the rate of fallout can be changed. This rate of fallout will depend also on the rate of replacement in the cloud. One of the difficulties is to calculate the seeding pattern. Skills are being constantly improved in evaluating the results of cloud seeding and in determining equitable methods of proper payments.

Many states have legislation requiring that weather control operations be conducted only by those with expert knowledge in the field to avoid overlapping of operations and to provide for proper recording of results. Federal legislation looking to this same end is now under consideration.

Watershed Control
Roy W. Morse
Robert A. Duff

Future Resources
Fred Merryfield

Resources Chmn.
A. D. Henderson

Weather Control
Irving P. Krick

Radar & Rainfall
A. M. Buswell

Water Works Management Division Sessions

Presiding officers were: Chairman, N. S. Bubbis; Co-Chairman, Frank C. Amsbary, Jr.; Assoc. presiding officer, L. W. Grayson.

"MR. ONE DROP" was the title of a motion picture shown by courtesy of the Johnston Pump Co.

The theme of this picture is the use and value of water in crop production by irrigation. It depicts the sequence of steps in making studies of irrigation needs, manufacturing needed equipment, shipping and installing these products on a project in Formosa.

Insurance Rating

"FIRE INSURANCE RATING PROBLEMS" was the title of a panel discussion with A. A. Ulrich, Mgr., Massillon District, Ohio Water Service Co., Massillon, Ohio, serving as moderator.

ROBERT C. DENNETT, Consultant, National Board of Fire Underwriters, New York, N. Y.—"THE RATING SCHEDULE OF THE NATIONAL BOARD OF FIRE UNDERWRITERS."

The National Board of Fire Underwriters includes about 200 insurance companies. It operates through several committees which employ experts in various fields. The first rating schedule was published in 1916. These schedules are now used by practically all companies as standards of rating fire protection facilities.

Ratings are given by the assignment of deficiencies. A maximum of 1700 points of deficiency are divided into 10 classes of 170 points each. The better or the more effective any portion of the fire protection system, the smaller will be the number of points of deficiency in that class and the larger the final number of points rating. For example, a gravity water system will have a lower deficiency than a system requiring pumping. Adequacy and reliability are important factors in determining the rating.

A comparison of ratings of a number of cities at 10 year intervals indicates an average improvement in the period of 121 points or 25 per cent.

LOREN J. BUSH, Chief Engineer, Board of Fire Underwriters of Pacific, San Francisco, California—"RATING SCHEDULES AS RELATED TO SMALLER CITIES."

Larger cities — over 35,000 — are graded by the National Board of Fire Underwriters. The smaller cities are graded by local bureaus, either regional or state. The same schedule of deficiency points and methods of rating are used in all cases.

As a rule, the smaller cities have more difficulty in reaching standards of fire protection than the larger cities. Fire protection rating reports are confidential in nature.

Fire insurance companies have large sums represented in liability in every community. Mr. Bush pointed out that both these companies and property owners have mutual interests in improved fire protection.

PAUL J. BRAUN, Public Fire Protection Engineer, Washington Surveying and Rating Bureau, Seattle, Washington—"RATE MAKING FROM STANDPOINT OF STATE RATING BUREAU."

Fire insurance premiums depend on two factors:

1. Extent of coverage—which, in general, property owner controls.
2. Rate applicable to property—which usually is beyond property owner's control.

Predictions depend on past experience, the period of time, and area covered by data.

Factors affecting the risk, according to Mr. Braun, are: (1) construction, (2) occupancy, (3) exposure, and (4) protection.

Changes in a rating for a community affect all types of property. Any type of building in a city of Class 2 rating would carry a much lower insurance rate than the same building in a city of poorer rating. A decrease in the fire risk to any property has value for all the other property in the community.

Automatic sprinkler installations are considered valuable additions to fire protection. The use of such equipment is sometimes discouraged by high connection and installation costs.

HENRY R. HEROLD, Assoc. Engineer, City Water Department, Seattle, Washington — "RATING AND GRADING."

Recent inspections and grading in Seattle were described. Mr. Herold emphasized the importance of having fire protection facilities in suburban areas adjacent to cities planned with city officials, since the later annexation of such areas is often delayed due to their poor fire protection.

On Vancouver Island: Post Conference Trip to Victoria

No. 1—The Lancasters (Kearny, Neb.); the Weirs (St. Louis); the Prays (Ft. Dodge, Ia.). No. 2—The Ritters (Baltimore, Md.. No. 3—Luncheon at the famed Hotel Empress. No. 4—The Morrises (Los Angeles). No. 5—"The Three Musketeers": "Spec" Bolls and Ed Farmer (Black and Veatch, Kansas City, Mo.), with John Hawkins (Grennville, S. C.).

In a discussion period conducted by Mr. Ulrich, Moderator, at the close of the panel presentation, it was pointed out that National, Regional, and State Rating Bureaus remove the necessity for many separate inspections by individual insurance companies. A few Factory Mutual Companies still want to make their own inspections.

The dollar relationship between insurance premiums in a community and the cost of improving the fire insurance rating in that community is valuable information for the city officials and citizens in promoting bond issues for such improvements. This information can often be obtained from local rating bureaus. There is no direct relationship between them which will apply to all areas or sections.

In general, a pressure of 60 lbs. per sq. in. is considered the minimum desirable in a water distribution system from the fire protection standpoint, with deficiencies being charged for lower pressures.

Rules and Regulations

"The Utility Commissioners' Standard Rules and Regulations" by John H. Murdoch, Jr., Vice-President and Counsel, American Water Works Service Co., Philadelphia, Pa.

In his paper Mr. Murdoch discussed what he considered the more important sections of the National Association of Railroad and Utility Commissioners' (NARUC) Regulations. The object of the NARUC is to set up high uniform standards and to encourage all to meet these standards. The Association has gathered considerable information of a broad character.

The "Refusal To Serve" regulation which permits a utility to refuse service where such service would adversely affect other customers is considered questionable in value by the author. He considers such a regulation sound where the installation would be hazardous.

Another regulation involving implications and considered of doubtful value relates to the right of the utility to inspect the plumbing of an applicant for service before making the connection and the right to refuse such connection if the plumbing is not in accord with city regulations. Such a regulation places undue responsibility on the water utility and has been found difficult to enforce.

According to NARUC Regulations, standard pressures may be set for each of several districts. In no case shall the deviation in any district exceed 50 percent of the standard pressure set for that district. Pressures should never fall below 25 lbs. per sq. in. or exceed 125 lbs. per sq. in. New connections are only to be made where the probable income will warrant. All connections are to be metered and the water sold except connections for fire, street flushing, and similar public uses.

Public Relations

"Public Relations Practices That Work!" by Paul Weir, General Manager, Atlanta Water Works, Atlanta, Georgia.

The author believes that there are two important correlated principles in good public relations: informing the public and doing a good job for them. In making the best use of opportunities for informing the public, imagination, a sense of humor, and a government to back you up are essential.

A locally-made motion picture was used by Mr. Weir to illustrate "Public Relations Highlights." This film is considered very valuable by the water department of his city.

Important events in the growth of the Atlanta Water Department, which provided a good opportunity for valuable public relations and the manner in which this was done, were illustrated clearly. In the setting of the one hundred thousandth water meter, 200 public officials and prominent citizens participated. When a 36-inch main broke, flooding a section of the city, the method of by-passing, the fact that service was interrupted for only one hour and forty-five minutes, the thirty-seven years of service of the pipe, and the method of repairing the break were brought to the attention of the public by press and radio without delay. The cleaning of 150,000 feet of water main, 80 per cent of the work being done in the day time, was described in the newspapers, along with the information that this cleaning operation would result in an ultimate saving to the citizens of a million dollars.

Additional projects serving as the basis for desirable publicity were the dedication of a new 50 million gallon pump, the construction of a new 48 inch steel water main, and a reduction in fire insurance rates of one-half million dollars in the past year alone due to improvements in the water system. Mr. Weir stated that an exhibit was maintained at all times in a conspicuous location in the City Hall showing water consumers such things as a typical meter and service installation, illustrations of how to read a meter, typical service troubles, and the operations of the Service Department in handling an average of 600 calls a day.

At the second session of the Water Works Management Division, chairman W. A. Glass presided.

Regional Water Systems

"Regional-Metropolitan Water Systems" was the subject of a Panel Discussion moderated by Dr. Abel Wolman, Prof. of Sanitary Eng., Johns Hopkins University, who commented on the high importance of the topic, which is not only a nationwide but an international problem.

E. H. Campbell, Asst. Director, Dept. of Political Science, Univ. of Washington, Seattle, remarked on the friction between municipalities and suburban areas created by water and sewage service and charges for such. He cited as successful the Metropolitan Water and Sewage Districts of Greater Vancouver serving 14 municipalities and the Victoria District serving a number of communi-

Here and There on the Post Conference "Voyage Abroad" to Victoria on Canada's Famed Vancouver Island.

ties. The newest of such arrangements is that serving the Toronto area which was created Jan. 1, 1954, as the "Municipality of Metropolitan Toronto," a new political subdivision serving 1,172,550 people in an area seven times that of the city of Toronto. The water and sewerage facilities of the area will be operated under a Commissioner of Works. Water produced in existing or new plants will be sold wholesale to the various municipalities and lesser communities at wholesale rates for distribution by each at local rates. Sewage service will be provided on some basis of payment to "Metropolitan Toronto" for treatment in existing or new plants.

Mr. Campbell stated that the legalization of financing through Revenue Bonds makes possible the establishment of Metropolitan Utility Districts without exceeding legal tax limits, heretofore a serious hurdle to such developments.

ROB'T B. DIEMER, Genl. Mgr. and Chief Engr., Metro. Water Distr. of Southern California, sketched the history and operations of the Water District (limited to water supply) which he heads and is controlled by a 29 member Board of Directors. The District is a separate political entity with all powers of a municipality. Water is sold at wholesale rates set by the Board. Special assessments are required in instances with payments distributed over a 30-year period. The District Board can levy taxes on real or even personal property. The counties must collect such taxes. Bond issues must be voted in every case—the period being 15 to 50 years. Court tests have in all cases shown the District legal.

H. H. GERSTEIN, Ass't. Chief Engr., Dept. of Water and Sewers, Chicago, stated that under the Chicago Sanitary Distr. Act the city of Chicago has for years been required to supply purified water to suburbs and surrounding municipalities at the same wholesale rates as those charged to taxpayers in Chicago. In all, 51 incorporated communities are being so supplied at the rate of almost 9 mgd at the 12c per 1000 gal. rate. How long this is to continue is a problem, especially when Chicago is building another new filtration plant in its five year improvement program. Incidentally, the court announced during the Seattle conference that the injunction asked by property owners to stop construction of the new filtration plant on the Northside had been denied.

JOHN W. MCFARLAND, Genl. Mgr., East Bay Munic. Utilities Distr., Oakland, Calif., stated that the East Bay Distr. was established by legislative act in 1921 and now serves 1,000,000 people with an 115 mgd supply—all at retail rates. The present debt on reservoirs, transmission and treatment facilities is $45 million. The year's budget is $15 million and about $7 million is plowed back from profits and everybody seems to be satisfied.

HARRY B. SHAW, Chief Engr., Washington (D. C.) Suburban Sanitary Commission, Hyattsville, Md., revealed that this early experiment in Metropolitan Utility Districts dates back to 1918. In addition to water and sewage service the commission is charged with refuse and garbage disposal, and more recently with flood control. Three commissioners control the operations and have the rights of eminent domain. Financing of construction is based on front foot taxes and assessments. All operating and maintenance must come from revenues.

Mr. Shaw said that the District had suffered growing pains as the result of the great housing developments surrounding Washington. Several small filtration plants and impounding reservoirs had been built and existing water systems purchased. Sewage plants and incinerators had been built, the former now being abandoned and sewage being delivered to D. C. trunk sewers for treatment in the District's plant at an equitable charge to the Suburban District which collects a sewer service charge from users. Incinerator operation is also paid from collection charges. Starting in 1918 to serve a population of only 32,000 the present population had increased to 425,000 spread over 212 square miles. Facilities are now worth one billion dollars on which a $75 million debt is being amortized from operating profits.

Revenue Bond Financing

"REVENUE BONDS IN THE WATER SUPPLY FIELD" was reviewed by D. L. ERICKSON, City Engr., Lincoln, Neb., who revealed that financing of water supply betterments with Revenue Bonds is now legal in 38 states. In general the interest rates on Revenue Bonds are presently from the same to 1.5 times those of Genl. Obligation Bonds which means 1.67% to 4% maximum. Lincoln sold a 30 year issue at an interest rate of 2.29%. Mr. Erickson referred his listeners to the results of a survey of Revenue Bond Financing of Water Works published in the April 1954 issue of the A.W.W.A. Journal, representing a 70% reply to the questionnaire. We recommend this report for careful scrutiny, the trend being strongly to financing through Revenue Bonds.

G. W. FRANCIS, Manager, Francis Engineering Co., Saginaw, Mich., reported that as far back as 1895 Revenue Bonds had been used for water supply financing in Spokane, Wash. At present issuance of Revenue Bonds is legal in 38 states but what is needed is greater uniformity of legislation pertaining to Revenue Bond financing in the various states.

When a referendum is required in connection with Revenue Bonds, voting should not be limited to property owners as in the case of Gen'l. Obligation Bonds. There should be no limit on life of Revenue Bonds, 35 to 40 years being reasonable. There should be no legal limit to size of issue. Issues should be sold through competitive bidding and interest rates should be no more than 1.5 times rates for Gen'l. Obligation Bonds, if that. The market for soundly planned Revenue Bonds is excellent.

LAUREN W. GRAYSON, Gen'l. Mgr. and Chief Engr., Dept. of Public Services, Glendale, Calif., emphasized the value of careful procedure in Revenue Bond financing in its relation to the competitive bidding and interest rate required. Revenue Bond financing is the most certain way of holding income in the Water Department. If voted by the public this feature becomes the more certain. In California a two-thirds "yes" vote in

bond elections is required. Glendale's city charter had to be amended to permit Revenue Bond financing, two years being the time taken to get the legislation change through. Glendale's first R. B. issue sold at an interest rate of less than 2%, the later issue at 2.5%.

Transmission and Distribution Division Session*

'PORTLAND'S NEW SUPPLY LINE" was described by BEN S. MORROW, Engr. and Gen. Mgr., Bureau of Water Works, Portland, Oregon.

The City of Portland has added a new 25-mile steel supply line to its facilities, increasing its transmission line capacity an additional 100 mgd. Contracts were awarded in April 1952 and the line was completed in December 1953, at a cost of $4,795,675.00. Ten miles of the pipe line is 66-in. diameter and the remaining 15 miles is 56-in. diameter.

Pipe for the line was rolled into 35-foot lengths, and then shop welded into 70-foot lengths for transportation to the job site. A special trailer was obtained to handle the 70-foot lengths of pipe.

The 70-foot pipe lengths were joined in the field with Dresser couplings for about 98 per cent of the total 25-mile length. A 3,200-foot length through Sandy River Canyon was joined by welding. The pipe and the Dresser couplings were tar coated inside and out. The maximum amount of pipe laid in one day was 1,540 feet.

Many Uses of Steel Pipe

"UNUSUAL INSTALLATIONS OF STEEL PIPE" were reviewed in a paper prepared by JULIEN HINDS, Mgr. and Chief Engr., United Water Conservation Dist., Santa Paula, California.

Mr. Hinds' paper, read by R. B. DISMER of the Metropolitan Water District of South California, presented a long list of unusual and interesting steel pipe line installations throughout the world. Interesting details of some of these installations are:

Steel pipe has been used for water mains since about 1860. Between 1860 and 1930, riveted construction was largely employed. Lock-bar steel pipe construction came into existence in 1905, and was in wide use until the early 1930's, when the welding processes were developed extensively.

The 250-mile long High Sierras and Owens River aqueduct, having a 400 second-foot capacity, was completed by the City of Los Angeles in 1913. Maximum diameter of the 13 inverted steel siphons is 11 feet. Maximum head is 850 feet, maximum plate thickness is 1⅛ inches, and construction is of the riveted type.

The 94-inch diameter Bouquet Canyon Inlet-Outlet pipe line, completed by the City of Los Angeles in 1934, was the first major steel water pipe line of all-welded construction. It is also the first major pipe line coated on the inside with the modern type of coal tar enamel.

The Colorado River Aqueduct (Metropolitan Water District of Southern California), 242 miles in length, constructed during the 1930's, with an ultimate capacity of 1600 ft. is one of the most colossal aqueducts in the world. Delivery lines from the five pumping plants are 10 feet in diameter, of welded steel pipe, supported by ring girders; they lift water 1617 feet.

The San Joaquin Valley siphons of San Francisco's 150 mile, 400 mgd Hetch Hetchy Aqueduct are each 47½ miles in length, have a maximum head of about 500 feet and consist of 66 to 56-in. diameter welded steel pipe.

The San Joaquin Valley siphon of East Bay's 94 mile Mokelumne Aqueduct, is 81 miles long and 65 in. in diameter. This line, started in 1924, was the first major all shop-welded steel water line ever built. The field joints were riveted.

The largest steel pipe lines are the 30-feet diameter penstocks of Hoover Dam, located on the Colorado River, with plate thickness up to 2⅞ inches. The maximum head is approximately 500 feet.

In Switzerland, the 1934 Dixence Power Plant has a 56-inch to 39-inch diameter penstock subjected to a head of 5,750 feet (2,473 psi). The upper portion of the pipe is welded, while the lower portion is banded.

Steel pipe lines have been successfully suspended across canyons or rivers, and have been installed under water ways. A 30-in. diameter welded steel pipe line under high pressure is support across the Colorado River on a suspension bridge, having a clear span of 1,040 feet. The underwater bay crossing of San Francisco's Hetch Hetchy system consists of two welded steel pipe lines, 54 inches in diameter by ¾ inch thickness by 2800 feet long each, encased with 6 inches of concrete.

Discussion

A discussion of the preceding paper, prepared by G. R. SCOTT, Black and Veatch, Consulting Engineers, was read by T. B. ROBINSON, Prin. Engr. of the same firm. It described the 30-inch steel pipe, now under construction, which will increase the water supply for Colorado Springs, Colorado. The line will transport water by gravity from the Continental Divide near Alma, Colorado, to the city, a distance of about 72 miles. The entire length of the line is an inverted siphon with high operating heads; exceeding 1,000 feet over much of the length, and reaching a maximum of 1900 feet. The capacity of the line will be 18 mgd.

Oil Pipeline Crossings Panel Discussion

The panel discussion, introduced by W. V. WEIR, Pres., St. Louis County Water Co., was arranged to consider the harm and danger to public water supply occurring by reason of petroleum pipe line breaks at river crossings. The panel members were from both public water supply utilities and the petroleum pipe line industry.

M. B. CUNNINGHAM, Supt. and Engr., Oklahoma City Water Dept., stated that there are 82 oil pipe line crossings in the drainage area above the intakes of Oklahoma City's water supply. Each of these pipe lines has valves installed where the pipe line enters the drainage area. The water department has the authority to close any valve should the city's water supply be threatened by a pipe line break. In addition, the drainage area is banked into a series of earth reservoirs, so interconnected by piping that leakage from an oil pipe line could be isolated. No oil leakage has ever reached the Oklahoma City's water supply.

J. C. DETWEILER, Genl. Supt., Water Operations Dept., Omaha, Nebraska, described Omaha's experience.

On August 3, 1953, a break in a gasoline pipe line river crossing, 60 miles upstream from Omaha, dumped 40,000 to 50,000 gallons of gasoline into the Missouri River. On the next days numerous water consumer complaints of an oily taste were received. After receipt of these complaints, an oily film was observed on the water plant basins. Activated carbon applied did not remove the taste. Previous pipe line breaks above Omaha had not caused consumer complaint.

Mr. Detweiler proposed that the pipe line companies should immediately report their pipe line breaks to endangered downstream water utilities.

M. P. HATCHER, Director, Water Dept., Kansas City, Missouri, reported experience with gasoline "spills."

*This session was reported by H. O. Hartung, Production Supt., St. Louis Cty. Water Co., University City, St. Louis, Mo.

Insurance Panel
A. A. Ulrich

Utility Rules
J. H. Murdoch, Jr.

Public Relations
Paul Weir

Regional Systems
Abel Wolman

Revenue Bonds
D. L. Erickson
L. W. Grayson

Presiding
W. A. Glass

Panelists
Harry B. Shaw
H. H. Gerstein

Kansas City water consumers experienced the effects of a gasoline pipe line break in the Missouri River on October 1, 1953. The break in the pipe line was two miles upstream from the purification plant intakes and occurred sometime during the night or previous day. At 8 A.M. the purification plant operators noticed the odor of gasoline coming from the basins. At about the same time the gasoline odor was discovered in the basins, consumer complaints were beginning to be received. By 12 noon the complaint load was equal to the capacity of 6 or 7 telephones.

The odor of gasoline was finally eliminated from the water supply by removing the top 4 inches of sand from the filters, by washing filter walls and by hydrant flushing.

On October 2, 1953, more gasoline was spilled into the river. The pipe line company notified the water department of this second accident. Water quality contamination and complaints were prevented by stopping the intake pumps until the gasoline had passed the intakes.

Mr. Hatcher made two observations in connection with these pipe line failures:

(1) It is very important that public water supply utilities be promptly notified each time of an oil pipe line break.

(2) There is no public (state or federal) agency to which the water department could turn for help in this matter.

E. A. SCHMITT, Engineer, Washington, D. C., reported on a visit to the Corps of Engineers Office, The Commerce Department, and the Interior Department in Washington, where he learned that none of these agencies claimed authority over pipe line river crossing construction methods which pertain to the prevention of public water supply contamination.

W. V. WEIR, President, St. Louis County Water Co., described a 20-inch crude oil pipe line, crossing the Missouri River. A break occurred in this line seven miles above the St. Louis County Water Company's plant, about 2 A.M. on January 13, 1950. At approximately 8 A.M., the plant operators at the St. Louis County Water Company observed oil on the preliminary settling basins. Heavy petroleum odors were coming from the river at the same time. Intake pumps were shut down and pumping was not resumed until 12 hours later. Even then, the river water was not yet entirely free of petroleum odors.

A telephone call was made about 9 A.M. to the pipe line company having a crossing nearest to the plant to determine the cause of the oil in the river. The person answering the telephone indicated his company was aware of a break, that pipe line pumping had been discontinued, but that the location of the break had not been determined. Valving off the line to prevent the remaining contents of the line from draining into the river, presumably had not been done.

This pipe line failure did not affect the water consumer. However, the reserve storage of the St. Louis County Water Company was seriously taxed, and on a higher water consumption day would not have been adequate.

F. L. SCHERER, Asst. Genl. Manager, Texas Pipe Line Co., Houston, Texas, expressed the desire of the Petroleum Pipe Line industry to cooperate with A.W.W.A. in a joint study of the problem of pipe line breaks and their effect upon public water supply. The industry is already applying many protective devices to prevent such breaks. In addition to its recognized responsibility to prevent water supply contamination, the industry also is concerned with product loss when such breaks occur.

Some pipe line stream crossing breaks are considered inevitable because it is impossible to predict when river channels will shift or when the river will meander.

Mr. Scherer specifically suggested that:

(1) A joint A.P.I., A.W.W.A. committee be established to study the problem.

(2) Water utilities inform themselves regarding the number and nature of pipe line crossings which could affect their water supply.

(3) A reporting procedure be developed for use when pipe line crossings fail.

At the second transmission and distribution session, vice-chairman Max Socha presided.

Wood-Stave Pipe

"SERVICE OF WOOL-STAVE PIPE" was reviewed by JOHN W. CUNNINGHAM, Consulting Engr., Portland, Ore., who related the history of continuous wood-stave pipe which had served the northwest country so well. Machine banded stave pipe came into use in 1910, fir and redwood being the woods most used. World War II and steel shortages gave renewed impetus to the wire wrapped stave-pipe. Creosoted staves gave trouble with chlorination, ammonia being required

In Breath-taking Butchart Gardens Near Victoria

The center picture is of the centuries old specimen Douglas Fir of Washington State on exhibit at the Seattle Auditorium.

to prevent taste formation. Although wood pipe possessed the most desirable capacity characteristics, difficulties in maintaining a non-leaking line were against its desirability, so it lost out to steel, cast iron and concrete pipe.

Valves for Water Works

"VALVES—WHAT TYPE AND WHERE?" was the interesting question discussed in an excellent analysis by LESLIE PAUL, Supervising Mech. Engr., East Bay Munic. Utilities Distr., Oakland, Calif.

Based on long experience and trying service for valves of various types under high heads, Mr. Paul gave facts and opinions relating to valves and valve service in his highly illuminating paper which all valve users will want to refer to for facts vs. fancy in valve selection and valve service.

There had not been found a check valve which would dependably eliminate water-hammer. Needle valves could be used in place of cone valves. Experience with 4 to 72-inch butterfly valves indicated rubber lined (rubber seat) for pressures up to 125 lbs. and metal to metal seats for higher pressures. Butterfly type valves had proved successful as automatic stop valves. For 36" and larger sizes, butterfly valves are the least expensive. Mr. Paul warned, though, that great scrutiny must be used in selecting butterfly valves. Short face to face dimensions add attractiveness in the large installations. The District has 26 butterfly valves between 36" and 72" diameter.

Concerning Plug Type Valves, with 75 in use as manual throttling and elevation control valves, after 13 years service there had been no grease leakage.

Ball Type Valves are meeting with favor and as a throttling device Globe Type Valves have no superior.

As to Gate Valves, these are deficient as operating valves. Comparing the solid wedge with double disc valves, because of durability the solid wedge type had proved more desirable. However the wedging mechanism needed improvement. Double disc valves can be installed horizontally but vertical installation proves preferable.

D. W. HOPKINS, Vice-Pres., R-S Products Corp., Philadelphia, sparked the discussion by stating that gate valves should probably be limited to sizes up to 16 inch. Frequently, to reduce costs, a cone valve of less than pipe diameter could be installed, with flare pipe on each side.

The question of the difference between a cone and ball valve was raised by a member. This created quite a difference in opinion between manufacturers of the two types of valve. The impression left was that the cone-valve could take more punishment and was more rugged.

Someone pointed to the fact that the speed of closure of the smaller cone for ball type valve presented greater danger of water hammer than the slower closing gate valve.

Cavitation

"THE CAUSE OF CAVITATION AND CORRECTIVES" was discussed by W. W. TINNISWOOD, Applications Engr., Caskey Engineering Co., Seattle, Wash., who presented an astounding movie taken at speed of 20,000 frames per second through clear plastic to show the formation and collapse of the vapor bubbles which create cavitation. The reverse of explosions, the collapse of these vapor bubbles are being termed "implosions" which at speeds of 800 ft/sec create the "water-hammers" of machine-gun tempo to blast out the metal similar to shot-blast. Created by instantaneous negative head the life of the vapor bubble from formation to collapse is in all only 3/1000ths of a second. In short, cavitation is caused by velocity-head.

To reduce or eliminate cavitation there are two possibilities:

(1) Create higher head on pump or conduit.
(2) Create higher head on pump inlet to overcome vapor-pressure.

In the discussion, Mr. Tinniswood stated that it wouldn't pay as a rule to design to prevent cavitation. The more practical approach would be the use of a hard resistant alloy such as chrome-nickel-steel. Metallizing with such hard alloy applied to the cavitated areas had proved a practical method. Others had used stainless steel on the affected areas.

W. A. KUNIGK, Supt. of Water, Tacoma, Wash., explained a serious cavitation problem created by a pressure reduction valve. After studying several possibilities of correcting the cavitation, including admission of air and pressure increase at the cavitation location, a more thorough study was made by the Univ. of Washington. From these studies a design had evolved wherein head will be destroyed through a spiral flow chamber such as has been successfully employed in open drop shafts on large water conduits. If the device is successful it will replace the pressure reducing valves held responsible for the destructive cavitation.

W&SW

Aukland, N. Z., to Follow Recommendations of Panel of Overseas Sewerage Experts

In our issue of May, 1954, on page 90-A we published a brief account of the retention of five experts in sewage and trades waste disposal from the U. S. and Britain by the Metropolitan Drainage Board of Aukland, New Zealand, for the purpose of studying and advising the Board relative to our unusually complicated problem in sewage and trade waste disposal.

The panel consisted of:

AM Rawn, Chief, Los Angeles Sanitation Dist.
Chas. Gilman Hyde, Cons. Engr., Berkeley, Calif.
D. H. Caldwell, Cons. Chem. Engr., San Francisco
John T. Calvert, Cons. Engr., London
Dr. H. Wilson, Cons. Bio-Chemist, London

We counted it quite a compliment to have three of our west coast sanitary engineering experts selected by the Aukland authorities to guide them in the prosecution of what now appears to be a $25,000,000 project.

On July 8th the Metropolitan Drainage Board (D. M. Robinson, chairman, and C. C. Collum, chief engineer) announced that the recommendations of their Overseas Panel of Experts would be followed.

WATER WORKS PRACTICES

Flow Measurement

The Fourteenth of a Series

by GEORGE E. SYMONS, Ph.D., Consultant and Technical Editor, Larchmont, N. Y.

IN THE previous lecture, it was pointed out that flow measurement is a part of hydrodynamics, and a number of reasons were outlined for measuring flow in water works practice. This lecture will be devoted to developing some of the details of the subject of flow measurement.

A . . . Fundamental Concepts

1. DEFINITIONS

a. *Quantity* is volume contained in a confined space.

(1) Figure 1 shows a liquid at rest, with quantity in the pipe between points 1 and 2 represented by the equation

$$\text{Vol.} = A \times L \qquad \text{Eq. 1}$$

(2) Volume is in cu ft, A is area in sq. ft. and L is length in ft.

b. *Flow* or discharge (Q) is quantity in movement past a point in a specified interval of time.

(1) When the liquid moves from one point to another, due to pressure (head) as indicated in Fig. 2, the quantity moving becomes the number of times the length of pipe (L) is filled and emptied in a given period of time (T).

(2) Since L/T = velocity, therefore flow or quantity in motion (discharge) is expressed by the equation

$$Q = A \times V \qquad \text{Eq. 2}$$

(3) In this case Q = volume in cu ft per unit time (T), A is area in sq ft and V is velocity in ft per unit time (T); usually per sec (or min).

c. *Velocity* or some function of it is a fundamental factor in flow measurement; all measuring devices are based on this concept.

d. *Rate of flow* is the term applied to measurements of quantity in motion for a relatively short period of time; for example, per second, per minute or per hour and, sometimes, per day.

e. *Total flow* is the term applied to the total amount of liquid moved during any unit of time, usually referring to a period of a day, a month, or a year. Total flow equals average rate of flow multiplied by time.

f. *Units of flow* commonly used in water works practice are: cubic feet per second (cfs), gallons per minute (gpm), and million gallons per day (mgd).

2. REASONS FOR FLOW MEASUREMENT

a. *To provide data* and information on plant production.

(1) Rates of plant output as well as pressure in the lines are important in plant operation, since consumption varies during the course of a day and at times of fires.

(2) Total plant production data in a day, week, month or year serve not only for comparative purposes, but help to chart trends for future planning.

(3) Both rate of operation and total output of individual operating units aid in the proper operation and maintenance of plant units.

. . . In particular, individual filters, pumps, wells, wash water, and sometimes coagulation and sedimentation tanks are units on which operating data are important.

. . . Chemical feeder operation, likewise, is important, but this is a subject to be discussed in a later lecture.

. . . Electricity consumption data are important to determination of operation costs and efficiency, but a discussion of electricity flow measurement is not included in this lecture.

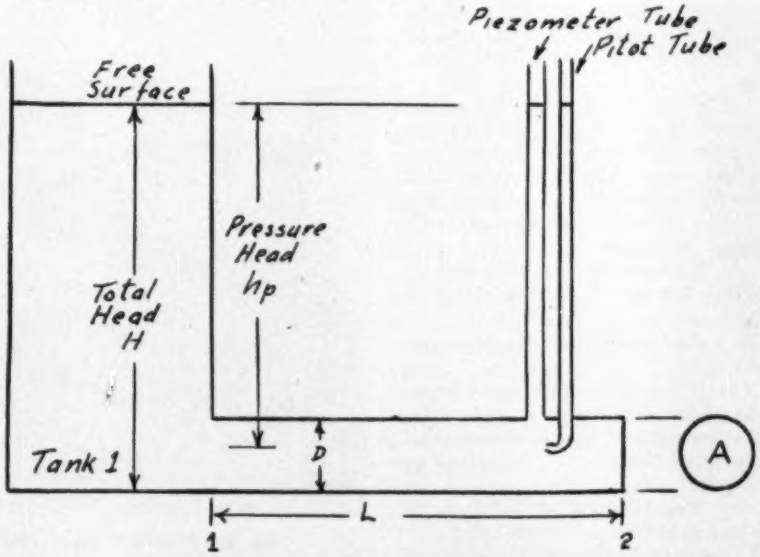


Fig. 1—WATER in pipe under pressure, not flowing

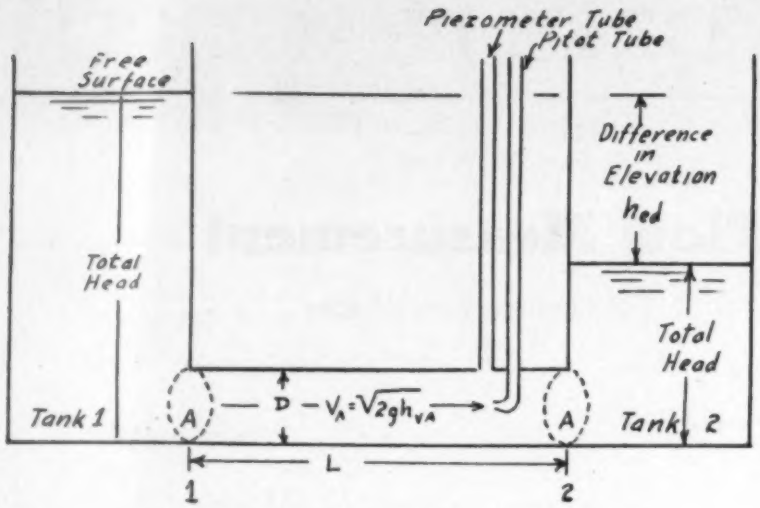


Fig. 2—WATER in pipe under pressure, flowing

b. *To provide information* on operation efficiency.

(1) Both unit operations and total plant output should be subjected to efficiency calculations.

. . . Filtering, filter washing, and pumping are three such unit operations.

(2) Individual well operation and output, drawdown, and specific capacity of wells are important in ground water supplies and well field operation.

c. *To provide control* of unit operations.

(1) Measurement of flow in distribution systems can be used to control pump operation or elevated tank operation.

(2) Measurement of flow in treatment plants can be used to control the operation of chemical feeders and other treatment operations.

(3) Flow measurement is used to control the rate of flow through filters, through the use of rate controllers which actually measure the flow and maintain the desired rate in spite of increasing loss of head during operation.

(4) Flow measurement is used to control the rate of backwashing of filters.

d. *To ascertain quantity* of water sold.

(1) If water is delivered wholesale from one supply to another, measurement of flow is essential to determine the amount delivered to the purchaser.

(2) Measurement of flow to individual consumers, by totalizing meters, is used to determine the basis of billing customers.

(3) Non-revenue water, often called unaccounted-for water, is a measure of overall efficiency. It is determined by comparing the measured amount of water pumped or distributed with the quantity of water sold (and paid for) as determined from customers' meters, or from estimations of consumption.

e. *To determine costs* of operation.

(1) Overall operating costs are important to public, and private water works and to industrial water supplies.

(2) Costs of operation are usually based on million gallon production, but sometimes are given per thousand gallons.

f. *To provide records* of permanence.

(1) Most state health departments require records of operations in public water supplies.

(2) Management of water supply operations needs records as essential tools in proper supervision.

(3) Owners, both stockholders in private companies and taxpayers in public utilities, want to know what their properties have done and are doing.

3. Metering Points

a. Meter locations selected depend on several considerations:

(1) Source of supply
- Surface
- Ground

(2) Type of Treatment
- Coagulation and Sedimentation
- Filtration
- Softening

(3) Type of Distribution
- Gravity
- Pumped

(4) Information Desired

b. Meter locations are seldom a matter of cost, since the cost of metering equipment is only a small percentage of the total cost of a water works. The more complete the metering in any plant, the more complete will be the information on all phases of operation.

c. Individual points of locating

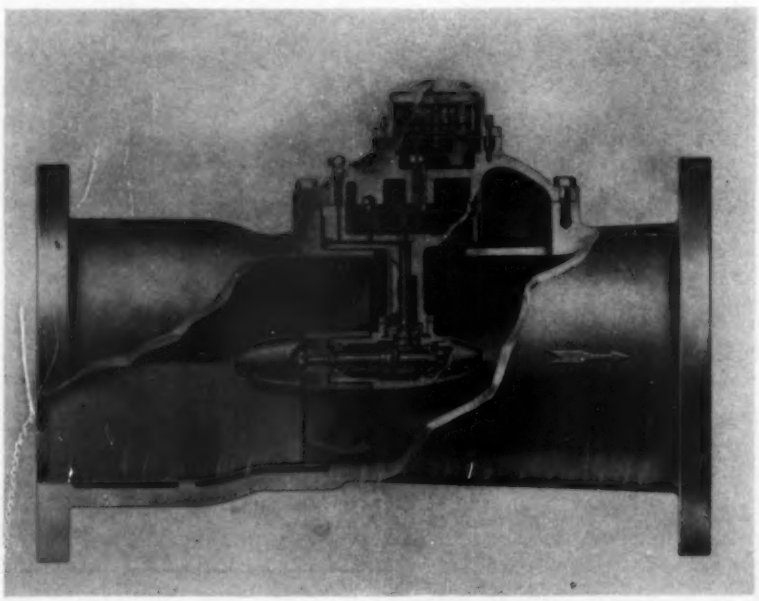


Fig. 3—VELOCITY meter (Builders Propeloflo in cutaway view)

Note Venturi design and streamlined nose of propeller mechanism

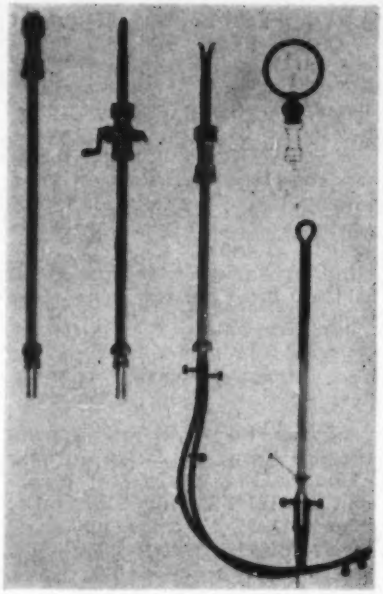


Fig. 4—PITOMETER rods and manometer

flow metering devices include:

(1) Source of supply
- Letdown from reservoir storage
- Raw surface water intake
- Raw water pump output
  - Individual and total
- Well field output
  - Individual wells and total

(2) Treatment
- Flow to or from groups of coagulation and settling or softening units
- Wash water to supply tank
- Wash water to filters
- Effluent from filters
  - Individual
  - Groups
  - Total
- Finished water to clear wells

(3) Distribution
- Gravity transmission mains and conduits
- High service pump discharge
- Elevated tank storage
- Booster pump discharge

(4) Plant Water Supply
- Inside
- Outside

B . . . Devices for Flow Measurement

1. HEAD-AREA METERS

a. Flow measuring devices used only for open channel flow or flow in partly filled pipes.

(1) These devices operate on the principle that a constriction or controlled barrier in the flow channel will back-up the liquid creating a higher level (or head) than the level below the barrier.

(2) The head or elevation of the liquid above the barrier is a function of the velocity of flow and therefore of the volume flowing through a known constriction, per unit time.

b. *Weirs* are dams of predetermined cross-section, the discharge characteristics of which are known.

c. *Measuring flumes* are constricted channels of predetermined dimensions, the most widely known of which is the Parshall Flume.

d. *Open End Nozzles* consist of a constriction at the end of a pipe, flowing partially full, and from which the flow drops without interference to a lower level.

e. Head-area meters cannot be used on lines under pressure but are used to measure flow from reservoirs in open conduits or in the letdown of water from impounded reservoirs.

2. FUNCTIONAL METERS

a. Mechanical devices which measure some function of volume in movement and which by means of other mechanical devices convert that measurement into rate of flow or total quantity of flow.

b. *Differential head devices* produce a difference in pressure head between two points on the device as liquid passes through.

(1) Essential part of these meters is a constriction in the line of flow; this constriction causes a change in velocity of flow accompanied by a change in pressure head.

. . . Change in pressure (or differential head) between the two points in the measuring device is proportional to the square of the flow.

(2) Differential-head meters include the Venturi tube, insert nozzle, orifice, and Dall flow tube and Gentile flow tube.

(3) Differential head meters are used for main line metering and in metering flows at any point where water moves in a confined pipe under pressure.

c. *Velocity meters* consist of a device by which a vane or propeller is inserted in a pipe line at a point of definite cross sectional area. (Fig. 3)

(1) The propeller turns in direct ratio to the velocity of liquid flow and therefore is a measure of rate of flow.

(2) Velocity meters are used for main line metering, pump discharges, etc. A velocity type meter used in open channel flow is known as a current meter.

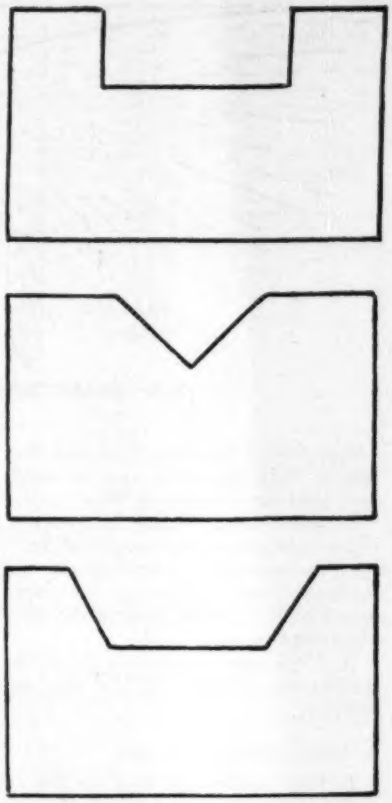


Fig. 5—WEIR types Top: Rectangular Center: V-Notch Bottom: Cipolletti

d. *Pitot tubes* will determine the velocity of liquid flow at a point of known cross-sectional area.

(1) The Pitot tube consists of a vertical tube with a tip, at right angles, which is inserted in an open conduit with the tip facing upstream.

. . . The height to which the liquid rises in the tube is a function of velocity and hence rate of flow.

. . . Another type uses one tip facing upstream and a static tube opening into the wall of the pipe line.

(2) For use in closed systems under pressure two tubes are used, one facing upstream, one downstream, (Fig. 4) and the difference in height to which the liquid rises in the two tubes is a function of velocity and hence rate of flow.

(3) Pitot tubes are used principally to study flow in distribution systems, particularly to determine leak losses.

3. PUMPS

a. The number of repeat cycles of operation of a pump can be used as

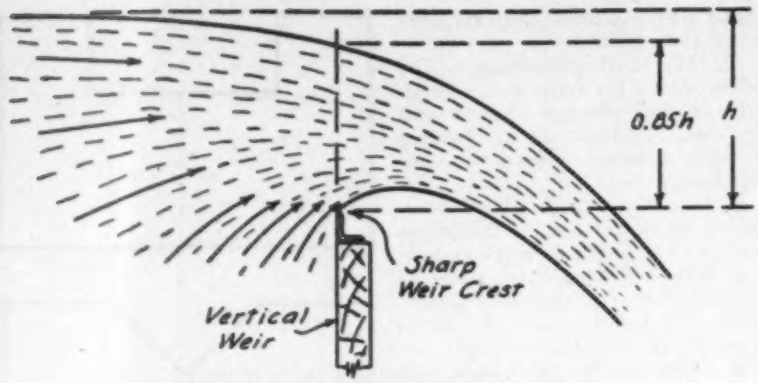


Fig. 6—CHARACTERISTICS of flow over weir

a measure of the total flow and the rate of this operation can be used as a measure of rate of flow.

b. Controlled volume reciprocating pumps give a constant output.

c. Centrifugal pumps, must be calibrated as to discharge for each speed of operation, suction lift and discharge pressure.

d. The use of pumps as flow measuring devices is not recommended.

4. Displacement Meters

a. One method of flow measurement is based on the fill and draw principle, whereby the volume of liquid is determined by the change in liquid level in a vessel, tank or reservoir.

b. In this method, the change in level must be due solely to liquid entering or leaving the reservoir or tank, and input and output cannot take place at the same time.

c. Fill and draw measurements are utilized in measuring liquids in reservoirs, either by determining change in level in the reservoir or change in pressure in the discharge line. (Rate of flow can be determined only by timing the rate of change in level or pressure.)

d. When the fill and draw principle is applied to a closed device in which a closed compartment is alternately filled and emptied, the device is known as a displacement meter.

e. Displacement meters in small sizes are used for measuring water use by consumers.

5. Miscellaneous Devices

a. *Gravimetric scales* can be used to determine weight of liquid in a confined area, either in batch movement of liquids or in loss-in-weight scales which continually indicate and record decrease of weight of the container. Tank cars are the largest feasible size of container to be weighed and measured in this manner, and the measurement of liquid chemicals is the only application of this method in water works practice.

b. *Constant differential meters* consist of a tapered tube, smaller at the bottom than at top, in which is confined a movable element called a "float".

(1) The difference in pressure above and below the "float" remains constant; the "float" rises in the tube as the flow increases and the position of the movable element gives a measure of instantaneous rate of flow.

(2) This device is generally called a "rotameter" and is not used for measuring large flows.

c. *Inertial Flow Meters* do not measure volume but determine mass by measuring an inertia force of a moving mass.

(1) The massometer or Coriolis flow meter consists of a rotating disc in a confined flow; it measures the force necessary to accelerate the flow to the outer rim of the disc.

(2) The Gyro flow meter measures the precession effect of liquid passing through a circular pipe which rotates as a gyroscope while liquid is passing.

(3) These devices are new in the field of flow measurement since 1950.

C . . . Head Area Meters

1. Weirs

a. Weirs may be of three general shapes (Fig. 5): Rectangular V-Notch, Trapezoidal (Cipolletti weir has sides sloping 4 vertical to 1 horizontal). Weirs are generally sharp crested so that the liquid will break cleanly from the crest (Fig. 6) although broad crested weirs may be used.

b. The surface height (or head) of liquid above the weir crest is a function of velocity, and thus is a function of volume of flow because the cross-section of the weir is known.

(1) The point at which the height or head (h) is measured must be upstream from the weir a distance of three times the maximum head to be expected, because as the liquid approaches the weir the elevation of the surface decreases (See Fig. 6).

(2) Determination of the head (h) may be made as follows:

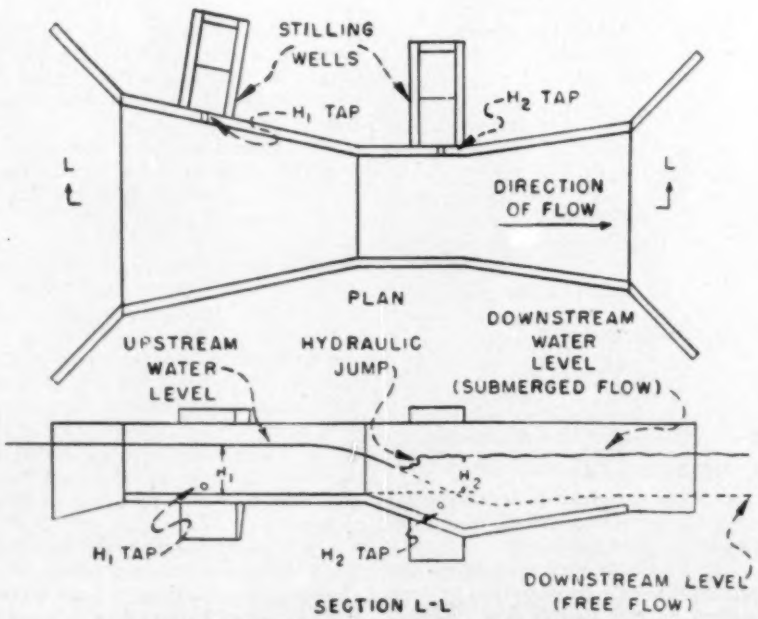


Fig. 7—PARSHALL flume; basic elements of design

Staff gage or rule (zero mark at elevation of weir crest)
Float gage
Plumb bob on measured line lowered from a reference point until tip just ripples flowing surface
Hook gage (pointed metal hook raised from beneath until the point breaks the surface)
Where the flow is turbulent, a stilling well may be used.

(3) Substitution of the value of "h" in proper formula for a particular weir will give the rate of flow. . . . Rectangular weir formula is

$$Q = 3.33 \times L \times h \times \sqrt{h}$$

where Q = cu ft per sec
L = weir length in ft
h = head in ft

. . . There are several other weir formulas in use.

. . . If the weir ends are sharp-edged so that the liquid flow is contracted as it passes through (a contracted weir) the value of L in the above formula is multiplied by a factor (less than 1.0). If the weir ends are smooth, it is called a suppressed weir.

. . . V-Notch weirs are best suited for low flows and the angle of the notch may be from 90° to 15°, but 90° and 60° notches are most common. Formulas for V-Notch weir flow measurement are:

For 90° — $G = 2.284\ (h)^{5/2}$
For 60° — $G = 1.3125\ (h)^{5/2}$
Where G = gpm and "h" is in inches

. . . Trapezoidal weirs are used where the channel is large and the head cannot be great with respect to width of weir.

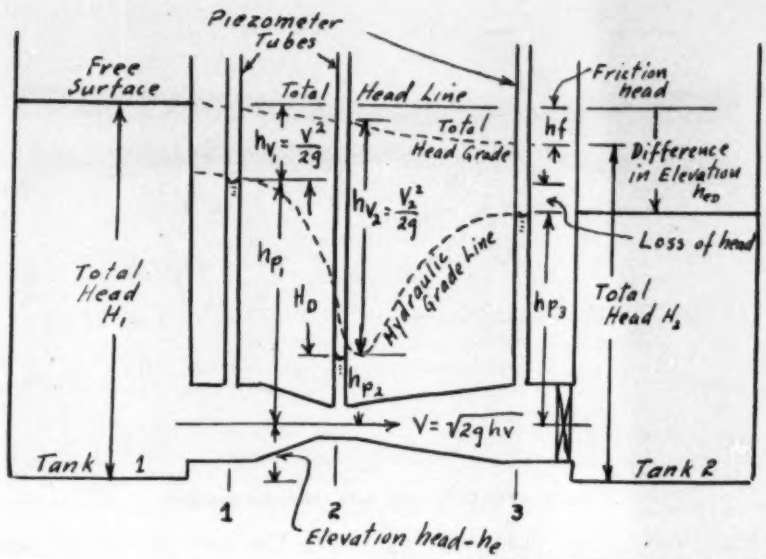
(4) For accuracy, all weir formulas need to be corrected for friction, contraction and other factors.

. . . Tables and charts are available to convert heads over weirs to "Q" values. (See: Wat. & Sew. Wks., *98*, April 1951, p. R-182-R-183)

(5) Open channel flow may be calculated by determining velocity of flow between two points at different elevations of flow and plotting a curve relating flow quantities to flow depth. This curve is based on the Chezy formula:

$$V = C\sqrt{Rs}$$

where V = mean velocity in ft per sec
R = hydraulic radius (cross sectional area of the stream divided by wetted perimeter)
s = slope of hydraulic grade line
C = coefficient which varies with V, R and s according to Kutter's formula, wherein a factor of conduit roughness (n) is introduced



From B-I-F Industries Keep Sheet No. 23

Fig. 8—WATER under pressure flowing through differential producer

. . . Manning's formula is also used for calculating open channel flow:

$$V = \frac{1.486}{n} R^{2/3} s^{1/2}$$

where n = Kutter's n

. . . Formulas for open channel flow are not exact, but give good approximations if the conduit or channel is well constructed.

. . . Alignment charts and nomograms are available to make it easy to use these open channel flow formulas. (See various Reference and Data Editions of *Water Sewage Works* for these charts and tables).

2. Parshall Flume

a. The Parshall Flume is widely used for open channel flow measurements. It is an adaptation of the Venturi tube principle and requires exact construction limits.

b. The design (Fig. 7) consists of an entrance section with converging walls and level floor, a constricted throat section with parallel walls and downstream sloping floor, and a recovery section with diverging walls and rising floor.

(1) Stilling well and tap are placed in the converging section at a point two-thirds of the length of the converging section above the crest of the flume. The tap is at right angles to the wall at invert level.

(2) Dimensions must be held to close tolerances and to improve accuracy, liners of corrosion resistant material may be used.

c. Parshall flumes are useful where a minimum head loss is available.

(1) Accuracy depends on downstream elevation (height of surface above the floor) being held to less than a definite percentage of that upstream.

(2) Under conditions of "free flow", elevation of liquid downstream has no effect on discharge rate; under "submerged flow", where downstream backing-up occurs, the discharge rate will be retarded. (See texts on hydraulics for complete discussion of Parshall Flumes.)

3. Flow Nozzles

a. Flow nozzles are specially constricted outlets for placement at the end of a pipe flowing partly full and must discharge to a free fall.

b. Design of the constriction produces a definite relation of depth to flow.

c. Two types of nozzles are available: In one, the head has a direct straight line relation to flow; in the other, the relationship between head and flow is a parabolic curve.

D . . . Differential Head Meters

1. Fundamentals

a. In order to understand the operation of differential head meters it is necessary to refer to the general principles of hydrodynamics, outlined in Section C of the previous lecture.

(1) In particular, the relations between elevation, velocity and pressure heads are important.

(2) Definitions of total head, elevation head, pressure head, velocity

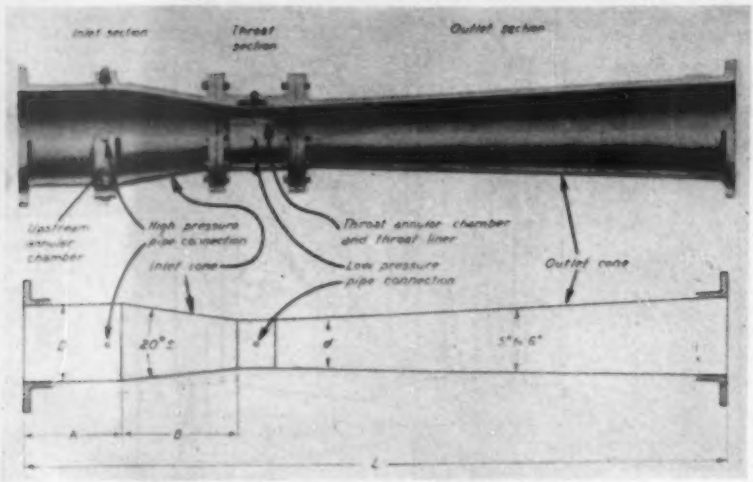


Fig. 9—VENTURI meter tube (Herschel standard)

head, and friction head must be known in order to understand the functioning of differential head meters. (See previous lecture.)

b. If water flowed through a smooth pipe without friction, the total head would be the same at all points in the pipe, even if the diameter or elevation of the pipe changed.

c. When water flows in a pipe, part of the total head is converted into energy of motion (kinetic energy) capable of lifting the water to a height called the velocity head.

(1) If there were no friction, water flowing through a pipe between two elevations would have the same velocity as a body falling freely between those two elevations or $V = \sqrt{2gh_v}$, where h_v is the height fallen.

(2) This relation appears in the figures in the previous lecture.

d. In any pipe, regardless of friction or variation in cross-sectional area of the pipe, an equal quantity of water must pass all points at the same instant.

This is the principle of "Continuity of Quantity" and is fundamental in the operation of differential head meters.

e. If a constriction is inserted in a piece of pipe (as shown in Fig. 8), the theory of differential head meters can be understood.

(1) With the valve closed, water does not flow and water in the piezometer tubes stand at the same elevation as the free surface in Tank 1.

(2) When the valve is opened, water will flow because of the difference in elevations between the two tanks.

. . . Part of the total head will be converted to veloc. head at point 1.

(3) The same quantity of water must pass points 1 and 2 during the same time interval; therefore the velocity at point 2 must increase proportionately to the decrease in cross section area.

. . . At the same time as the velocity increases, the velocity head increases and the pressure head decreases.

. . . The greater the velocity, the lower the pressure head at the constriction.

(4) Therefore, the difference in pressure head between the inlet and the constricted portion of a differential head producer is a measure of velocity which is a function of rate of flow.

. . . The rate of flow varies as the square root of the difference in pressure at the two points. This difference is called "differential head" or simply "differential".

. . . The greater the differential produced the more accurate is the determination of rate of flow.

. . . The increase in velocity is equal to $\sqrt{2gh_D}$, where h_D is the differential head and the flow formula derived from Equation 2 above, becomes

$$Q = A \times \sqrt{2g(h_D + h_{va})} \qquad \text{Eq. 3}$$

where Q = cu ft
A = cross section area in sq ft
h_D = Differential head in ft
h_{va} = Velocity head corresponding to velocity of approach at the inlet.

. . . The velocity of approach cannot be observed but it can be converted into a *velocity of approach* factor expressed as $1/\sqrt{1-\beta^4}$, where β is the Beta ratio, or ratio of diameter of the inlet (d) to the diameter of the throat (D), (that is, β = d/D).

f. Because of friction, water passing through any differential head producer loses some energy.

(1) This loss appears as a decrease in head (h_F) and is known as "loss of head" or simply, "head loss" (See Fig. 8).

(2) Head loss means power loss or need for power to overcome the head loss. Therefore, the most desirable characteristics in a differential head producing device (often referred to as the primary unit) are maximum differential and minimum head loss.

2. Venturi Tube

a. Essentially a section of pipe line, the Venturi Tube (Fig. 9) usually consists of an inlet section (a short cylinder "A" and truncated cone "B"), a cylindrical throat section (the most constricted part) and a long truncated cone recovery section which gradually returns to the original size of the pipe line.

b. The Venturi Tube was invented in 1887 by Clemens Herschel, an American engineer. He named the device for an Italian engineer who, a century earlier, first studied the relation of pressure head to velocity at a constriction in a tube.

c. Pressures at two points, inlet and constriction, are determined by the use of a piezometer ring, called an annular chamber or annulus, which serves as a means of determining the average pressure at that point since the ring surrounds the pipe and connects with it at several points on the circumference of the pipe.

d. The recovery section produces a high recovery (87 to 90 per cent) of loss of head. A shorter recovery section can be used but the permanent loss of head is greater.

e. Accuracy of Venturi Tube measurements will normally be on the order of ±2 per cent, but greater accuracy can be obtained by University calibration.

. . . Friction causes the actual flow to be less than the theoretical flow indicated by the differential head. Therefore each Venturi Tube has a discharge coefficient "C" to correct the observed value to the actual flow. This value of "C" may vary from 0.96 to 0.99, and will average approximately 0.98.

f. Taking into account correction factors, friction, velocity of approach, etc., the general flow formula becomes for the Venturi Tube or other differential producer.

$$Q = A \times C \times \frac{1}{\sqrt{1-\beta^4}} \sqrt{2gh_D} \qquad \text{Eq. 4}$$

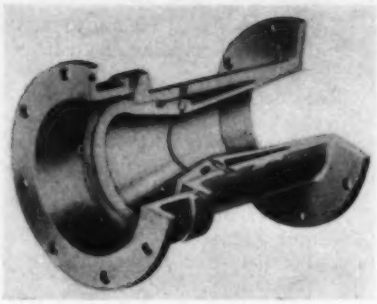


Fig. 10—DALL flow tube

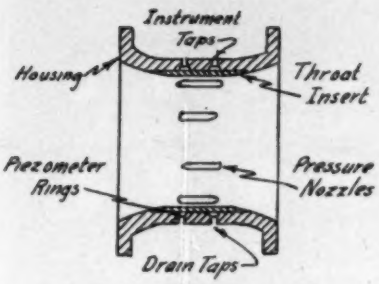


Fig. 11—GENTILE flow tube

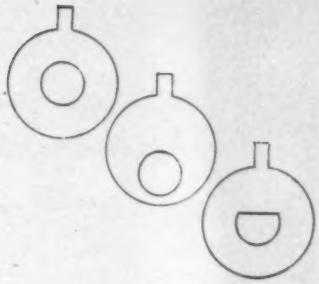


Fig. 12—ORIFICE plates—concentric, eccentric, segmental

where Q = cu ft per unit time
A = Area in sq ft
C = Coefficient of discharge = d/D
g = Gravity constant 32.16
h_D = Differential head in ft

3. Venturi Type Flow Tubes

a. The Dall Flow Tube (Fig. 10) is an accurate primary measuring device, which has the lowest permanent head loss (greater recovery of loss of head) of any known type of velocity-increasing differential producer.

b. The Dall Flow Tube consists of a flanged cylindrical body designed with a short straight line section that terminates with an abrupt decrease in diameter, or "inlet shoulder." This shoulder is followed by a conical restriction and a narrow annular gap, called the slotted throat annulus. The annular gap is followed by a diverging outlet "cone."

c. The Gentile Flow Tube (Fig. 11) consists of a device with a slight constriction in the walls of which there are pressure nozzles or ports, some facing upstream, some downstream.

d. One advantage of Venturi type flow tubes is the short laying length and low weight. Other advantages are described in manufacturers' bulletins.

4. Orifices

a. An Orifice is a thin flat plate, in which there is an opening smaller than the pipe in which the orifice plate is inserted between flanges.

b. A concentric orifice has a circular opening at the center of the pipe, an eccentric orifice has a circular opening tangent to the inside wall of the pipe. A segmental orifice has an opening bounded by the inner wall of the pipe and a chord of that circle. Orifice plates are shown in Fig. 12.

c. The orifice is, in effect, a dam behind which solid particles will collect. Fluids passing through orifices show a permanent loss of head of 40 to 90 per cent of the differential head depending on the Beta ratio of the orifice (that is, the recovery is 10 to 60 per cent).

d. A slight increase in pressure occurs just ahead of an orifice; there is a sudden drop in pressure on the downstream side of the orifice and a continued pressure drop before recovery starts. The point of minimum pressure (maximum velocity) is known as the Vena Contracta.

e. In the installation of orifices, attention must be given to the location of take-off points (called taps), at which pressures are measured. These locations are flange taps, radius taps, Vena Contracta taps, pipe taps and corner taps. Each will produce a slightly different differential head and the factor will be different for each in the general formula for differential producers given in Eq. 4.

f. Full information on installation and use of orifices may be found in standard reference texts on hydraulics.

5. Insert Nozzles

a. A nozzle-like concentric throat section, smaller than the pipe in which it is inserted, is called an insert nozzle.

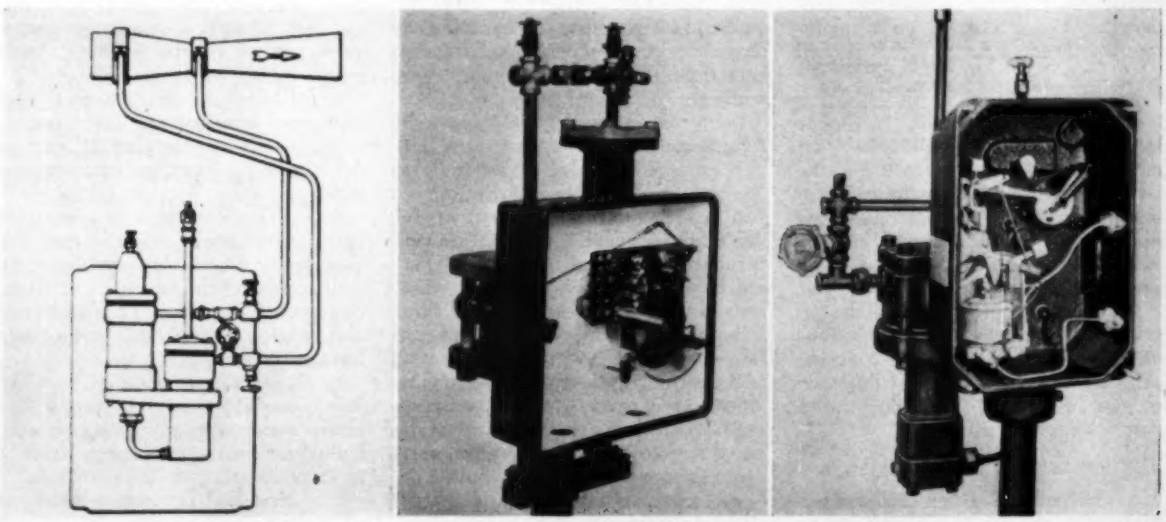


Fig. 13—TYPES of transmission

Mechanical Electrical Pneumatic

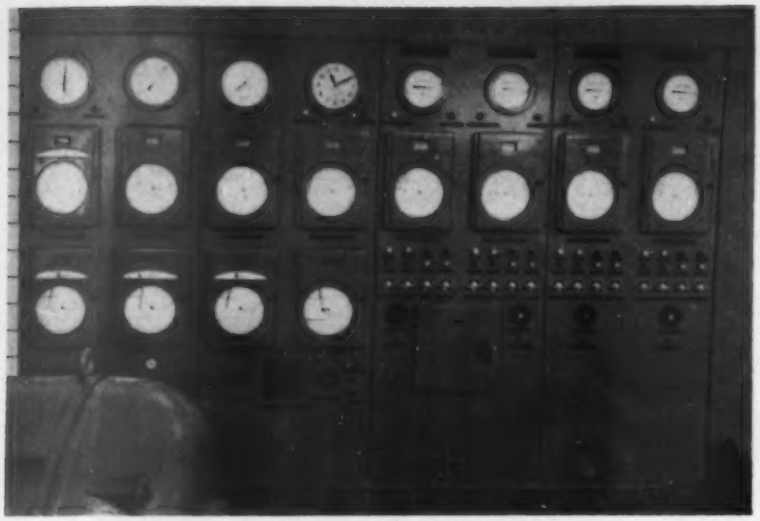


Fig. 14—CENTRALIZED control and meter panel

b. The simplest form is, in effect, an orifice plate with a cylindrical nozzle extending beyond the plate. It has many disadvantages of the orifice plate.

c. Variations of the insert nozzle are designed to improve the recoverable loss-of-head. These include the ASME long radius nozzle, the Venturi Flow Nozzle and the Builders-Schlag-Jorissen Tube.

E . . . Selection of Primary Units

1. General Considerations

a. The device which measures the flow (weir, Parshall flume, open nozzle, Venturi tube, Dall flow tube, orifice, etc.) is called the primary unit.

b. Considerations affecting the selection of primary devices include type of service, engineering factors, installation factors, accessories, comparative characteristics, and operators convenience.

2. Engineering Considerations

a. Principal engineering factors to be considered include allowable permanent loss of head, size of the constriction, differential pressure, flow disturbance due to upstream and downstream conditions (bends, valves, etc.), distance to secondary unit, and type of transmitter required.

b. Secondary engineering considerations include laying length, types of ends (bell and spigot, flange, concrete, or coupling), corrosion resistance required, cleanouts, inspection holes, manholes, pit forms, etc.

3. Comparative Considerations

a. Selection of a primary measuring device can be simplified by comparing several characteristics common to all. These characteristics include: Accuracy, cost, capacity, range, permanent head loss, life expectancy, freedom from field tapping, freedom from upstream disturbances, ability to handle liquids containing solids, ability to handle high pressures, laying length, and ease of installation.

b. A table (Builders-Providence, Inc. Tech. Memo H4A) shows a comparison of all these characteristics on a per cent basis with 100 per cent representing the device having the best performance in the characteristic listed.

4. Other Considerations

a. Installation factors take into account such items as position of device (vertical, inclined or horizontal), piping arrangements, vaults, bypasses, etc.

b. Accessories required may include: Straightening vanes, flushing devices, vents, vent cleaners, air chambers, float tubes, floats, sediment traps, seals, etc.

F . . . Secondary Instruments

1. Classification

a. A secondary instrument or receiver is the device used to convert information, sensed by and transmitted from the primary measuring unit, into observable information on flow. (Liquid level and pressure also can be shown on secondary instruments.)

b. Secondary instruments are classified in two ways—(a) According to type of information desired and (b) according to method of transmission from primary to secondary unit.

c. Classes by type of information desired include:

Indicator—Shows rate of flow, at moment of observation, in cfs, gpm, gph, mgd, etc.

Totalizer—Shows running total to time of observation, in cu ft, gal, mil gal, etc.

Recorder—Gives drawn record on chart, showing rate of flow as a continuous record for each instant during a particular period (hour, day, week)

(1) Combinations are available as Indicator-Recorder, Totalizer-Indicator, Totalizer-Recorder, and Totalizer-Indicator-Recorder.

(2) Indicators have a single arm and dial. Indicator-Recorders may have the indicator arm separate from the chart, or indicator arm attached to the pen arm.

d. Classes by type of transmission include: Mechanical, electrical, pneumatic.

2. Transmission

a. *Mechanical transmission* exists when the receiver is operated by cables directly connected to float wells which are in turn connected to the pressure takeoffs (taps) of the primary device.

. . . Mechanical transmission also may be produced by connecting the primary device pressure taps directly to mercury wells in the receiver unit. (Fig. 13).

b. *Electrical transmission* (Fig. 13) is used where the receiver cannot be located near the primary unit or where there is insufficient pressure for direct connection of primary to secondary unit.

(1) Electrical transmission is of the time-impulse type (Chronoflo Telemeter) whereby the length of time that the signal is transmitted is proportioned to the magnitude of the function being measured, (rate of flow, pressure, level, etc.). This signal can actuate a receiving instrument, control pumps, chemical feeders or valves, or both.

(2) Electrical transmission is possible over any distance from feet to miles, over telephone circuits, private A.C. or D.C. lines, or multi-service wires.

(3) A sequencing unit (Sequence Unit Transmitter) will transmit signals from several transmitters consecutively over the same pair of wires. Sequencing is useful in the operation and control of well field pumps and booster pumping stations.

c. *Pneumatic transmission* (Fig. 13) is useful up to 1500 feet; it generally makes use of a varying controlled-air-pressure ranging from 3 to 15 psi.

. . . Principal features are absence of wiring, continuous output signal (pressure), extreme sensitivity to change in variable being measured,

and immediate response to change in variable.

2. SUMMATION

a. Two or more flow rates of pumps, mains, filters, etc., may be added together to give a total of the combined flow on a single receiver. This addition is accomplished by a summator, either electrical or pneumatic.

b. The summator receives electrical signals (or pneumatic pressures) from the individual transmitters representing the two or more flows, adds the signals or pressures together and transmits a single signal (or pressure), representing the total flow, to the receiver.

c. The output signal (or pressure) from a summator may be used for controlling chemical feeders, pumps, and valves, as well as for metering.

3. RECEIVERS

a. Flow varies as the square root of head, therefore receivers are designed to convert the information received into the reading desired.

b. Charts may be of the square root type, with the divisions spaced according to the square of the unit. Readability of these charts is best at the high end of the scale.

c. Charts may be of the linear type, with divisions of equal distance for each unit and accurate readability at both ends of the scale. Linear unit scales are possible with a receiver containing a cam which extracts the square root of the head and converts it to linear measurement.

4. CONTROLS

a. Flow measurement can be used to provide control of flows, chemical feeding, proportioning, pumping, sampling, etc.

b. Mechanical, electrical or pneumatic means can be used for control purposes. The details of control mechanisms can be obtained from manufacturers of metering equipment.

c. Control of all processes and equipment can be placed in the superintendent's office or other central location through the use of centralized control panels (Fig. 14); all meters and control devices are brought together to simplify the supervision of operations, many of which can be made automatic in accord with conditions as sensed and indicated by primary measuring devices.

5. SELECTION OF SECONDARY INSTRUMENTS

a. The type of primary device, range of flows to be metered, and relative location of primary and secondary units have a direct bearing on the type of transmission used.

b. Accuracy is an important factor in selecting instruments; it depends not only on the primary unit but on the combination of primary and secondary devices.

c. Type of information desired (total, indicated, recorded), secondary functions desired (pacing, proportioning, control) are important considerations in the selection of secondary instruments.

d. Future plant capacity dictates the size of meter and receiver to be selected. Expected life of both primary and secondary devices are important factors in selection of instruments.

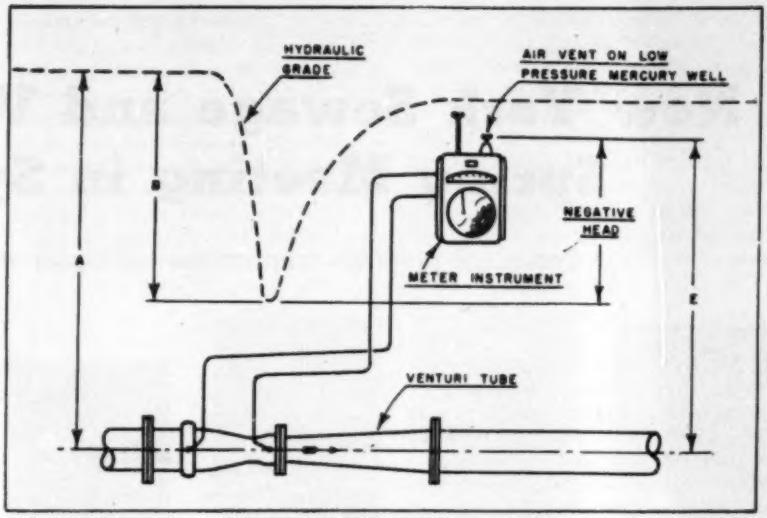


Fig. 15—EXAMPLE of negative head

G . . . Operating Problems

1. FOREIGN BODIES

a. Extraneous items such as bricks, rocks, concrete, construction equipment, lumber, grease, nuts, bolts, rope, jute, have been found in primary measuring devices.

b. Any foreign matter in a primary unit will adversely affect the pipes and accurate operation of flow measuring devices.

c. Remedy for foreign matter in metering devices is to remove it.

2. WEAR AND MOISTURE

a. Erosion of walls of a primary device due to gritty particles in a liquid will change its flow characteristics and cause a decrease in accuracy.

b. Wear on transmitter or receiver parts, especially on cams, will cause incorrect readings on the instrument.

c. Moisture in receivers may cause wrinkling of charts. A heating element or electric light bulb in the receiver case will prevent the difficulty.

3. NEGATIVE HEAD

a. Negative head (Fig. 15) exists in metering instruments if the pressure inside either or both mercury wells of a differential producer instrument is less than atmospheric; air may enter the connecting lines, become trapped, and cause an error in readings.

b. Causes and remedies for Negative Head are outlined in Keep Sheet No. 5 of B-I-F Industries, Inc.

4. MAINTENANCE

a. A knowledge of the construction, operation and adjustment of equipment, plus the proper tools, spare parts and a preventive maintenance schedule go a long way toward insuring against costly breakdowns.

b. Proper maintenance practice for flow measuring devices follows the rules of good maintenance, which will be the subject of a lecture later in this series.

H . . . References

Material for this lecture was adapted from an article on "Flow Measurement in Sewage Works," presented at the NYSIWA meeting in New York City in January, 1954.

Other reference material included:

King, H. W., "Handbook of Hydraulics" (McGraw-Hill)

Russell, George E., "Hydraulics" (Henry Holt)

Angus, R. W., "Hydraulics for the Practical Operator," Wat. & Sew. Wks., *95*, R-13 (1952)

Keep Sheets Nos. 5 and 23, B-I-F Industries, Inc.

NEXT LECTURE

The next lecture will be devoted to "Loss of Head."

W&SW

New York Sewage and Wastes Assn. Spring Meeting in Syracuse

Technical program emphasizes industrial waste treatment

THE New York State Sewage and Industrial Wastes Assn. held its spring meeting in Syracuse, N. Y., on June 14-15, 1954. Technical sessions included papers and discussions largely devoted to the treatment of industrial wastes. The afternoon of the second day featured an inspection trip to the City's Ley Creek Sewage Treatment Plant.

Presiding at the sessions were: president, William L. Edwards; vice-president, Clifford E. Irving; and program chairman, Kenneth S. Watson.

Officers
Wm. L. Edwards
Clifford E. Irving
R. C. Sweeney

Awardees
Robert Willett
H. B. Holcomb
Francis J. Cramer

Award Presentations

At the association luncheon, members were welcomed by DONALD H. MEAD, Mayor, City of Syracuse. The guest speaker was WALTER RANEY, Coach, Columbia University Varsity and JV crews.

Rating Awards were presented to four association members for their plant operation reports submitted for judging. The rating award committee consists of: J. A. Salvato, A. C. Hardy, and C. E. Irving, Chairman. Mr. Irving made presentations of the OPERATORS AWARD CUP to:

ROBERT WILLETT, Plant Supt., Hamburg, N. Y., for his report on operation of a sewage plant serving less than 10,000 population.

H. B. HOLCOMB, Chief Operator, Cortland, N. Y., for his report on a sewage plant serving more than 10,000 and less than 100,000 population.

The PREVIOUS WINNER'S AWARD, a certificate, was presented to:

FRANCIS J. CRAMER, Supt., Sewage Treatment Plant, Town of Greece, N. Y., for his report on operation of a plant serving more than 10,000 and less than 100,000 population.

UHL T. MANN, Supt., Ley Creek Sanitary District, Onondaga, N. Y., for his report on operation of a plant serving more than 100,000 population.

A program for ladies in attendance was organized by Mrs. H. H. Wagenhals, Mrs. W. H. Stewart, and Mrs. U. T. Mann. The program included a ladies' luncheon, a visit to the Syracuse China Plant, and a tour of the Rose Garden in Thornden Park.

Technical Sessions

Onondaga Lake Pollution

"THE CURRENT STATUS OF THE POLLUTION PROBLEM IN ONONDAGA LAKE" was discussed by A. F. DAPPERT, Exec. Secy., N. Y. State Water Pollution Control Board, Albany, N. Y.

At present, there is little evidence of improvements which will finally be accomplished by the pollution control program now under way. The problem has grown continuously more severe since a combined sewer system was constructed by Syracuse in 1870, until there now is pollution through all areas of Onondaga Lake. The city placed its first sewage treatment plant in operation (primary treatment and chlorination) in 1924—and the capacity of the plant was exceeded two years later. The lake now borders on a septic condition.

In the past, the Syracuse method of sludge disposal was unique: raw sludge was pumped to the Solvay chemical works, mixed with chemical waste which rendered the sewage sludge inoccuous, and sent to lagoons for drying. A large and continuous volume of chemical sludge was required for this method of disposal. Lately, the chemical sludge lagoons have been transferred to another area, and the city is studying methods of using trenches to dispose of sludge on city property.

In developing a comprehensive plan to deal with pollution, waters have recently been classified. Engineer's studies and conclusions have been presented for the Ley Creek Area on the north side of the lake. By 1975, it is estimated, about one-half of the pollution load will be contributed by that area—and about one-half by the city and west side area. A Joint Treatment plant is considered the best and most economical arrangement. This will require primary treatment (and the present Ley Creek plant will be converted to primary treatment). Plans have been received and generally approved by consulting engineers.

The Pollution Control Board will accept the plan now under consideration, though chemical precipitation might be required as additional treat-

ment during the bathing season. The city was notified that needed action should be decided upon by June 1, 1954. All recommendations are now under study, and Mr. Dappert predicted that good progress will be made.

Metallurgical Wastes

"THE TREATMENT OF MACHINE SHOP AND FOUNDRY WASTES" was described in a paper presented by C. W. HATHAWAY and R. E. HARVIE, Metallurgical Dept., Chevrolet Motor Div., Detroit, Mich.

Mr. Hathaway reported that the policy of General Motors is to eliminate or reduce wastes wherever it exists, rather than to treat waste. For example: in the case of cyanides, 90-95 per cent of use of cyanide-containing chemicals have been eliminated by substituting alternate processes which utilize less toxic materials. Similarly, waste pickle liquor has been eliminated in some instances and reduced in others, by using alternate processes.

At the Detroit plant of this firm, waste lime purchased from nearby industries is used to neutralize acid wastes as pretreatment before discharge to the municipal sewer. One of the wastes discharged to the Niagara River contains cyanide; pretreatment with sodium hypochlorite is used for cyanide destruction.

Emulsified and floating oils create a significant pollution problem. To treat wastes of this type, use is first made of gravity-type separators; the effluent is discharged to a 15,000-gal. holding tank. From the holding tank it flows to a 3,000-gal. treatment tank for treatment with alum and sulphuric acid; the effluent is discharged to a flotation unit where it is treated by aeration and with caustic soda. The effluent is finally discharged to the municipal sewer. To the skimmings from these processes, sulphuric acid is added, and heat is applied for final recovery of oil.

The new waste treatment plant at Niagara Falls was described: it will include in one building the treatment equipment, pumps, chemical storage, and laboratory facilities. Special effort has been made to specify protective coatings wherever required: Neoprene or lead for acid solutions, plastic-lined pipe for conveying corrosive liquids, and abrasion-resistant materials. Provisions will be made for cleaning pipelines wherever necessary.

In response to questions, Mr. Hathaway explained that oil wastes originally contain about 6,000 ppm of oil. The combined treatment processes described provide a final effluent in which the oil content is below 50 ppm.

County Engineer's Problems*

"A COUNTY PUBLIC HEALTH ENGINEER'S APPROACH TO THE PROBLEMS INVOLVING SEWERAGE AND SEWAGE TREATMENT" was the title of a paper presented by MICHAEL J. STANKEWICH, Chief, Bureau of Water & Sewage Control, Erie County Health Department, Buffalo, N. Y.

Mr. Stankewich outlined various reasons why new treatment facilities

Arrangements
John M. MacCrea
Uhl T. Mann
H. H. Wagenhals

Program Chmn.
Kenneth S. Watson

Program Comm.
C. J. Bernhardt

Programmer
A. F. Dappert

are lagging. He named continued cost rise, elaborate design, inadequate help, and pressure to keep down taxes. He emphasized the point that cost reductions may be necessary before we will see a trend toward the building of many new treatment plants. His remarks on "too elaborate designing" brought forth considerable comment from the floor.

THADDEUS J. PIECZONKA, Supt. of Sewage Treatment, Lackawanna, N. Y., discussed the paper given by Mr. Stankewich.

Mr. Pieczonka commented on the low salaries paid operators, and stated that the salary rate should be based on the value of the investment in the operators charge. He asked why secondary treatment should be used the entire year. He emphasized that money may be wasted in the building of elaborate structures, and in costly landscaping and grounds.

Elutriation Experience

"ELUTRIATION DIFFICULTIES AT THE BAY PARK SEWAGE TREATMENT WORKS" were described by ANTON E. SPARR, Supt. Bay Park Sewage Treatment Plant, Nassau County, Dept. of Public Works, East Rockaway, N. Y.

The Bay Park plant experiences indicate that solids undergoing compaction in the elutriator require adequate detention in order to obtain adequate concentration. At that plant, the volatile matter content appeared to be the most significant sludge characteristic in the operating economy of sludge elutriation and vacuum filtration.

Adjustment must be made for the volume occupied by the sludge undergoing concentration in determining the liquid detention time. The wash water is dependent upon the volume of sludge to be elutriated, the alkalinity to be removed from that sludge, the alkalinity of the effluent and the allowable liquid detention period. In the design and operation of an elutriator the quality of the effluent must be given serious consideration if detrimental, high solids-recirculating, loads are to be avoided.

Finally the limited plant scale study led to the development of a hypothetical relationship between the quality of the elutriation tank effluent and three factors. These are the dry solids loading, the volatile content of the sludge and the liquid detention time; they are combined to form a "Modified Sludge Factor." According to experience at the Bay State Park sewage treatment works, a "Containment-Modified Sludge Factor" relationship can be useful as an aid to the design and operation of elutriating facilities for a digested mixture of activated

*Four papers reviewed by Clifford E. Irving, Supt., Bureau of Sewage Treatment, City of Schenectady, N. Y.

Programmers
C. W. Hathaway
M. J. Stankewich
T. J. Pieczonka

Programmers
A. E. Sparr
D. F. Krawczyk
R. M. Austin

Programmers
E. K. Smith
W. B. Miller
W. D. Hanlon

and primary sludges.

Cyanide Determination

"A Review of Methods for the Determination of Cyanides in Sewage" was the title of a paper presented by Daniel F. Krawczyk, Associate Sanitary Chemist, Buffalo Sewer Authority, Buffalo, N. Y.

Mr. Krawczyk's review was an excellent summary of the methods of determining cyanides in sewage. He stated that cyanides have no place in the sewer system, even in concentrations as low as 0.1 ppm. He explained in detail the various methods for determining cyanides, and the laboratory procedures involved.

County Pollution Program

"The Development of a Program for Abatement of Pollution of Chautauqua Lake" was described by Roland M. Austin, Public Health Engineer, Chautauqua County, Mayville, N. Y.

Basically the lines of attack in the county's battle against water pollution lie along two separate fronts. The first front is in the nature of education, involving the schools of information inherent in the press, both in the form of newspaper articles, and explanatory pamphlets, demonstrations, exhibits and speeches on the subject of pollution control.

The second front consists of direct technical aid in the form of engineering advice and design for those with sewage disposal problems. Problems may range from institutional population of 200 down to the individual lake shore cottage. Mr. Austin stated that after the county engineers' recommendations are carried out, and pass inspection, a letter of approval (a permit) together with a metal approval plate, attractively printed in blue and orange, is presented. The approval is revoked and the permit withdrawn upon violation. Mr. Austin reported that this practice stimulates owners to "keep up with the Jones's."

Industrial Sewers

"Construction and Maintenance of Industrial Sewers" was described in a paper by Ernest K. Smith, Civil Engineer, Eastman Kodak Company, Rochester.

The Kodak Park Plant comprises an area of 579 acres. It has 14 miles of sewers, ranging in size from 8-in. to 48-in., to serve the 20,000 employees at the Plant. Sewers must be designed to carry acids, alkalies, and, in some instances hot waste water (often with temperatures as high as 130° F.). The use of vitrified tile pipe was recommended by Mr. Smith for sizes up to 36-in., but he suggested that concrete pipe can be used for larger sizes if a tile liner is installed, at least in the lower half of the sewer. The top half of the pipe should be painted with a bitumastic paint. Hot poured sulfur cements are successfully used at Kodak Park as joining compounds.

The maintenance of industrial sewers include inspection, cleaning and repair. Inspection, the most important, involves a safe method of visibly inspecting the sewer to determine the effect of deleterious material on the sewer. Mr. Smith described an automatic device which rings an alarm at the fire station to warn of an explosive mixture in the sewer. The Fire Department then flushes the sewer with additional water until the explosive limit is safely reduced. Mechanical sewer cleaners and sewer rods are used to clean plugged sewers.

Water Conservation Benefits

"Water Conservation and Resulting Waste Control Benefits at Electronics Park" was the subject to a joint paper by two engineers from the General Electric Company, W. B. Miller and V. De P. Lukas.

The plant, located five miles north of Syracuse, manufactures television and radio parts as well as varied electronic parts. The scarcity of water has encouraged the company to become water conscious. Drastic reductions have been made in water usage by water surveys, to determine where the water was being used, automatic controls, an educational program, reuse of water, by making use of water found on the plant site, and by softening or de-ionizing water.

Cooling water requires 40.3 per cent of the water used, process water 32.5 per cent, domestic requirements 21.1 per cent and miscellaneous usages 6.1 per cent. Mechanical refrigeration has resulted in water savings, as has the installation of cooling towers. Orifices, which allow only a predetermined quantity of water to flow despite the amount that the valve is opened, have aided in cutting the amount of water used. The installation of evaporative condensers has been responsible for savings of 415 million gallons of water per year. The authors encourage the use of recording or integral water meters for all principal users. The waste water from this plant is discharged directly to the Ley Creek sewage treatment plant.

Pharmaceutical Wastes

"WASTE DISPOSAL PROBLEMS IN A PHARMACEUTICAL PLANT" was the title of a paper presented by W. D. HANLON of Bristol Laboratories, Syracuse, New York.

Bristol Laboratories manufacture varied pharmaceutical products; the wastes from the production of penicillin and tetracycline produce the most serious treatment problems. Effluent is discharged to the Ley Creek plant without biological treatment. The pharmaceutical plant applies only neutralization of acid wastes with sodium hydroxide, and keeps a constant surveillance of the waste produced, in order to reduce the waste volume and to prevent deleterious substances (such as solvents) from entering the sewer. Automatic pH control to maintain a pH of 4.5 is considered adequate to keep the effluent from upsetting the Ley Creek plant.

Mr. Hanlon showed graphs indicating the population equivalent, on a B.O.D. basis, per gallon of these wastes. Per capita per gal. values as high as 1.0 were shown to be reduced to 0.2 after a cleanup of the wastes at the source. The B.O.D. load from the penicillin broth represents about 18-20 per cent of the total load from the plant. The author described the method of producing penicillin and pointed out that the principal wastes come from the waste broth, washing of equipment, acids and alkalies used in the refining process, as well as the treatment of weak solution of solvents resulting from the solvent recovery process. The "still bottoms" from the solvent recovery process represents a sizeable B.O.D. load.

Ley Creek Sewage Plant

"DESCRIPTION OF THE LEY CREEK PLANT" which was visited by the group at the afternoon's inspection trip was the theme of a paper by UHL T. MANN.

Mr. Mann is Superintendent of the Ley Creek Sanitary District which includes a small section of the city of Syracuse, all of the village of East Syracuse, several unincorporated communities and several highly concentrated industrial sites. The plant was enlarged in 1951 and presently includes mechanically cleaned bar screens, grit chambers, 8 primary tanks with 104,000 cu. ft. of tank capacity, 2 pre-aeration tanks with a detention time of 15 minutes, and 8 aeration tanks. The aeration units provide a detention period of 5.5 hours for a flow of 9 mgd plus 25 per cent return sludge, and the 4 final tanks provide a combined detention of 2 hours for 9 mgd flow. A magnetite sand filter was installed in the original plant but is not presently required.

Sludge digestion is accomplished with 145,000 cu. ft. of digester space, which represents a design load of 3.2 cu. ft. per capita. Heating is accomplished by means of external counter current heaters. For mixing there is a draft tube mixer. Chlorination is practiced before discharge to Ley Creek, which flows to Onondaga Lake.

The plant is so arranged that up to 9 mgd can be treated by conventional activated sludge, and the balance by plain aeration. This is done so that when industrial wastes affect the operation of the activated sludge process, the load on that part of the plant can be reduced and sent to the plain aeration section of the plant.

Since about 70 per cent of the load is from industrial sources, the B.O.D. of the influent varies greatly. The average daily flow during 1953 amounted to 5.91 mgd, the B.O.D. of the influent amounted to 459 ppm. The plain aeration part of the plant showed a reduction of 63.8 per cent (to 166 ppm), while 94.3 per cent was accomplished by activated sludge treatment. The effluent from activated sludge treatment averaged 24 ppm in B.O.D. Scum is removed from the clarifiers and incinerated with the screenings. The author believes that scum removal has considerably assisted in digester operation.

Wellington Donaldson Retires From New York City Sewage Post

Wellington Donaldson, "Duke" to his many friends in the water and sewage field, retired on August 1st, from his position as Deputy Director, Division of Sewage Disposal, Dept. of Sanitation, New York City. Since 1935, he served the city under several titles in executing assignments directed toward solving problems in sewage disposal operations and treatment plant design.

A substantial part of the New York City program for abatement of pollution, initiated earlier by Richard H. Gould, was consummated during the period 1935 to 1954. Eleven modern sewage treatment plants having an aggregate capacity of some 750 mgd., with intercepting sewers, were placed in operation. In this large accomplishment, "Duke" modestly points out that he shared responsibility with others for the many details of planning, execution and operation.

Mr. Donaldson received his engineering training at the University of Tennessee. His first employment in 1901 was with the Knoxville Water Company, Knoxville, Tenn., which he served for five years as resident engineer. For two years he was sanitary engineer and chemist for the Birmingham, Ala., Water Works Co.

In 1920, Mr. Donaldson joined Fuller & McClintock, Consulting Engineers of New York City as staff specialist on water purification, sewage treatment, and stream pollution problems. For the next fifteen years, he carried out studies and investigations relating to special projects. He had a responsible part in the firm's design of water and sewage treatment plants built in the U. S. and abroad; he started each of these in operation and trained their operating personnel.

Long an active member of technical associations, "Duke" has served especially the A.W.W.A., the A.S.C.E., the A.P.W.A., and the N. Y. Sewage and Industrial Wastes Assn. He is the recipient of the Kenneth Allen Award of the F. S. and I.W.A. He is the author of some 65 technical papers and reports. As reported in our May issue, he was recently awarded a commemorative plaque by the City of Memphis.

Both the water and sewage fields have benefited by the many technical contributions of Mr. Donaldson as well as by his personal participation. He may devote more time to his avocation of photography (in which he excels) but we feel certain that "Duke" will continue to be active in the profession he has served so long and so well.

Getting Away From The Crowd

The higher you climb on the ladder of accomplishment, the less company you will have.

SEWAGE treatment plant at Tiberias, Israel
Dosing tank in front of trickling filters, left, chlorination hut behind, sludge drying beds, center; Imhoff tanks, right.

Sewage Treatment at 600 Feet Below Sea-Level

Problems are unique in the ancient to of Tiberias on the Galilean Sea in the valley of the Jordan

by Y. PETER, *Director, Municipal Water Section, Ministry of Agriculture, Government of Israel, Tel-Aviv, Israel*

THE Holy Land is a marvelous country and contains opportunities and conditions not to be found elsewhere. Even the engineer is confronted, from time to time, with unique demands and difficulties. Such a unique problem confronted the writer in providing sewage treatment for the town of Tiberias.

Present City

The present town of Tiberias is situated in the Jordan Valley, along the Sea of Galilee, at a minimum elevation of about 600 feet below Mediterranean Sea level. Until the recent influx of population into Israel, the population of Tiberias was about 12,000 persons living on an area of about 450 acres. Domestic water consumption in the sub-tropical climate was about 40 gal. per capita per day. This water consumption is fairly high according to local standards, although far below American practice.

Disposal of sewage was left to individual arrangement for each house and generally consisted of a septic tank and percolation well. The soil of decomposed basalt does not have good leaching properties and the necessity of a modern sewage treatment works was evident.

With the influx of new immigrants and the erection of new housing schemes, this problem was accentuated, particularly with respect to a new quarter containing about 1500 persons on an area of about 30 acres. This problem was presented to the author in his official capacity. As the first stage of a program to meet

Fig. 2—OLD Roman well.

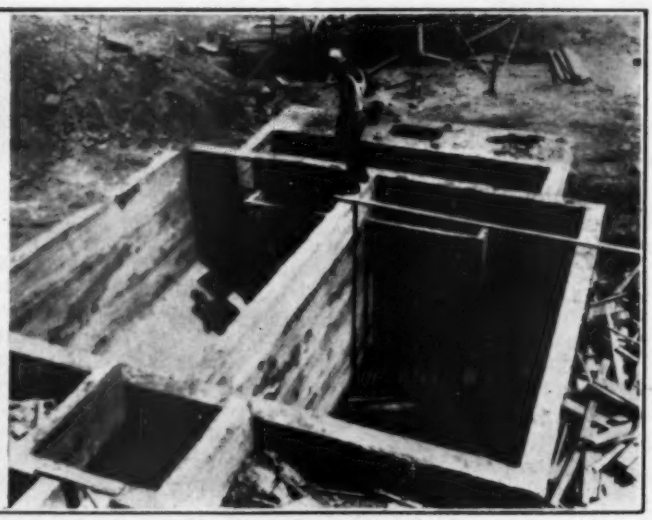


Fig. 3—IMHOFF tanks under construction.

the problem, a public sewer system and disposal plant was authorized for the new section. Full treatment with primary sedimentation plus trickling filters and sludge drying on beds was proposed, with the final effluent eventually to reach the Sea of Galilee. Special attention was required to avoid any nuisance in a holy place and tourist and health resort.

Ancient City

Engineering and town planning considerations dictated the choice of treatment plant site some 500 yards south of the new settlement. After the choice of site, the troubles began. The author was warned by the Antiquity Department that this chosen location was still within the precincts of the Old Tiberias. (See Fig. 1.) With this problem becoming evident, I was forced to delve a little into history.

It appears that the town was founded by Herodes, of ill-fame, shortly after the birth of Christ and was named in honor of the Roman Emperor, Tiberius. At the time of its splendor, it stretched over an area of some 2,000 acres, with a population of approximately a quarter million persons. With this history, the ruins of the town, now covered by several yards of historical fill and dust of more than a millennium, are sacrosanct to each archeologist worth his salt. These grounds, on which we planned to locate the new sewage plant, must not be disturbed according to the Antiquity Department.

Archeological Construction

Eventually a compromise was reached. Excavation for the sewage treatment plant was done by hand in true archeological style, under the direction of the Antiquity Department. The excess cost of this method of excavation over that of normal construction practice resulted in a slight overstrain of the budget, but was of necessity included by the unfortunate engineer of design.

The deep excavation for the Imhoff tanks reached down through 8,000 years to the dawn of history in the Bronze Age. The author requested that he be informed when the level of the "Golden Age" was reached, but it was not found. Nevertheless, more than 200 coins were found. The species of coin was not known, having been minted by the ancient City of Tiberias and the value of these coins, if brought on the market, amply justifies the precautions and extra expenditure involved. Such things happen in a history-soaked country like ours!

An unexpected windfall, which cut the proposed budget, occurred from this archeological digging. The treated and chlorinated effluent of the new plant was to be discharged into the Sea of Galilee by a pipe 140 yards in length. The excavation, however, revealed on the site an old Roman well (Fig. 2) which was successfully utilized for dispersing the effluent into underground strata.

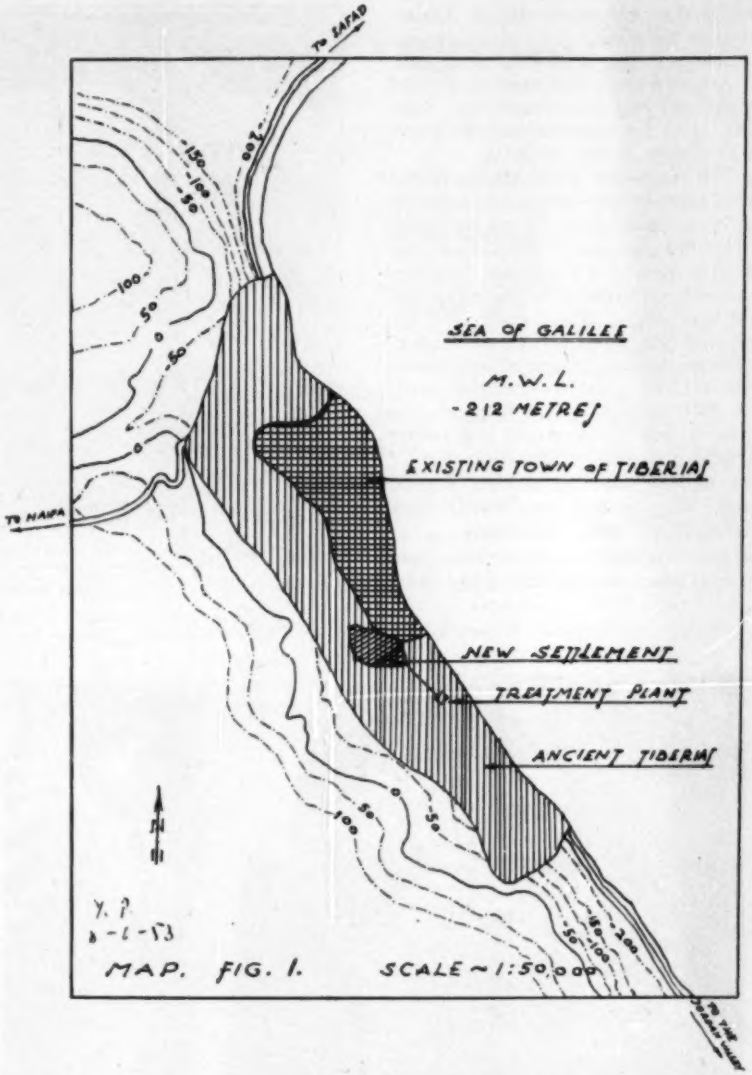
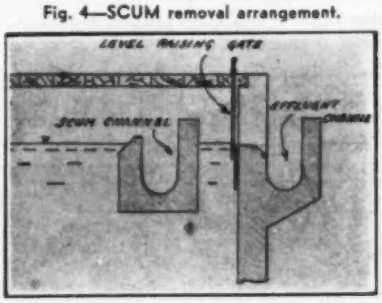


Fig. 1—MAP of ancient and modern Tiberias.

Fig. 4—SCUM removal arrangement.



Plant Design

From an engineering point of view, the following data may be of interest: Sedimentation and digestion of sludge are together effected in Imhoff tanks. This type of sedimentation tank has operation advantages in an underdeveloped country. The Imhoff tanks, of reinforced concrete construction, are covered with removable timber planks. (See Fig. 3.) Special arrangements were made to facilitate removal of scum from gas vents. (Fig. 4.)

Trickling filters are of standard rate type with rotary distribution. There is ample of head available to allow for gravity flow of sewage from the Imhoff tanks to the dosing tanks. These dosing tanks were designed in my office and fabricated locally. The pump for the return of humus sludge to the Imhoff tank is also made locally

and is the only power-driven mechanism in the plant.

Sludge drying beds (Fig. 5) consist of concrete slabs with open sand-filled joints and laid on a gravel bed. Suitable sand for conventional design is unavailable in the vicinity.

The treatment plant, shown in the head photograph, works satisfactorily with a minimum of maintenance. Dried digested sludge from the sludge beds is used as a low grade fertilizer and soil conditioner for the municipal gardens. Here, where once trod the sandals of an ancient civilization, modern sanitary engineering makes possible the growth of a new country with its roots going deep into the past. A link between past and future is afforded through the discharge of the effluent into an ancient Roman well. We, in this department, look forward to other developments of sanitary engineering as interesting and as important as this project has been.

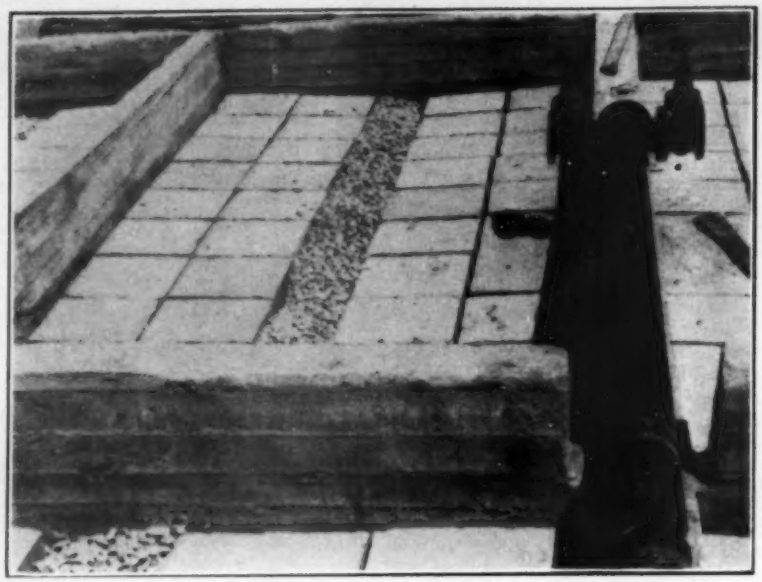


Fig. 5—SLUDGE drying beds.

Sierra Madre, Calif., Adopts Chlorination After Water Supply Pollution

When forest fires and flood damage caused pollution of the water supply of Sierra Madre, Calif., a trailer-mounted chlorinator became an effective disaster unit.

The chain of events leading to water pollution began with a brush fire which broke out in the canyons directly above Sierra Madre (population about 8,000). The fire continued unabated for four days, burning out several thousands of acres of mountainside. As a result, an otherwise effective watershed was rendered useless for that purpose, and also presented an unhealthy situation of flood potential. Despite immediate attempts at re-seeding—even to the extent of using a helicopter to scatter mustard seeds and other quick growing plants—floods hit the area on January 21, 1954. The floods were primarily mud slides which damaged some homes and left the streets of Sierra Madre knee deep in mud. More serious was the fact that contaminated flood waters, impounded back of the Sierra Madre flood control dam infiltrated into two tunnels which are used to deliver the domestic water supply for the city.

Following reports that members of about 100 families in Sierra Madre had been stricken with cramps and abdominal pains, the Los Angeles County Health Department issued a warning to residents to boil all water used for cooking and drinking until further notice. Trucks equipped with public address systems warned residents of the city to boil water before using. Announcements were also made over the radio networks.

On January 23, Sierra Madre and County Health officials accepted the loan of a trailer-mounted Fisher & Porter chlorinator, a unit normally used as a demonstrator for sales purposes. Shortly before noon the unit was connected to the water line of the main pumping plant and was operating. By one p.m. the following day, the town water was judged safe for drinking without boiling. Chlorination continued the following week until the seepage could be controlled.

In order to prevent recurrence of this unfortunate incident, the County Health Department immediately recommended the installation of permanent chlorination equipment. The City Council and the water superintendent took quick action to purchase and install such a unit.

Caution: Frequently the man who puts on too much "speed ahead" meets reverses.

A Financial Wizard: In these times is the man who insists on his family living on this month's income instead of next month's.

F. S. & I. W. A. Technical Program

27th Annual Meeting, Cincinnati, Ohio, October 11 to 14, 1954

THE following program, listing the technical sessions of the forthcoming 27th Annual Meeting of the Federation of Sewage and Industrial Wastes Assns., has just been released. All meetings and exhibits will be held in the Netherland Plaza Hotel.

F. S. & I. W. A. 1954 Meeting
Technical Sessions

Monday, October 11

Morning

Pollution Control in the Ohio Valley.....*Hudson Biery*
Solution of Cincinnati's Sewage Problems.....*Arthur D. Caster*

Afternoon

Evaluating the Variables in Vacuum Filtration....*Arnold J. Beck, E. N. Sakellariou and M. Krup*
Discussion.....*Robert D. Bargman*
Activated Sludge Thickening by Centrifuging....*R. E. Bragstad and Leland Bradney*
Discussion.....*L. S. Kraus*
Oxygen Absorption Efficiency Studies.....*A. A. Kalinske*
Discussion.....*Henry R. King*
Loading to Failure of a Pilot High-Rate Digester.....*Wilbur N. Torpey*
Discussion.....*Harry E. Schlenz*

Tuesday, October 12

Morning

Moving Picture—Diffusion of Effluents Discharged to Puget Sound.....*R. G. Tyler*
Treatment of Sewage Plant Effluent for Industrial Re-Use.....*R. J. Keating and V. J. Calise*
Electric Power Reliability Requirements in Sewage Works.....*E. O. Potthoff and N. L. Hadley*
Effects of Thermal Loadings on Stream Sanitation Criteria.....*Joseph R. Clark, Sheppard T. Powell and E. L. Knoedler*
Discussion.....*Lloyd R. Setter*
Increased Income for Inventors.....*Anthony J. Fischer*

Afternoon

Moving Picture—Sewer Maintenance Practice in Mexico City
Infiltration Specifications and Tests.....*Charles R. Velzy and J. M. Sprague*
Discussion.....*C. Gordon Gaither*
Safety in Sewage and Waste Treatment—Demonstration.....*L. W. VanKleeck*

Wednesday, October 13

Morning

Moving Picture—Clean Waters (New Revision)
Anaerobic Contact Process Applied to Packinghouse Wastes.....*George E. Schroepfer, W. J. Fullen, A. S. Johnson, N. R. Ziemke and J. J. Anderson*
Biological Properties and Behaviors of Cyanogenic Wastes.....*Charles E. Renn*
Discussion.....*C. M. Tarzwell*
Waste Pickle Liquor Disposal by Controlled Oxidation and Continuous Lime Treatment.....*L. W. Heise and Milton Johnson*
Discussion.....*Richard D. Hoak*
Application of Biological Treatment Processes to Industrial Wastes....*R. F. Weston and W. W. Eckenfelder, Jr.*
Discussion.....*B. W. Dickerson*

Afternoon

Inspection Trip to the Little Miami Sewage Treatment Plant and the Robert A. Taft Sanitary Engineering Center

Thursday, October 14

Morning—Concurrent Sessions

THE OPERATORS' FORUM.....*C. C. Larson, Leader*
Salary Schedules and Classifications.....*T. C. Schaetzle*
Biocatalysts in Sewage Treatment

INDUSTRIAL WASTES FORUM.....*Kenneth S. Watson, Leader*
Industrial Waste Specifications in Municipal Ordinances
Disposal to Public Sewers vs. Separate Treatment

Afternoon

Process Wastes from Petrochemicals Manufacture.....*O. C. Thompson and George F. Jenkins*
Discussion.....*E. B. Showell*
Ion Exchange Units for Treatment of Electroplating Wastes.....*T. J. Fadgen*
Treatment and Recovery of Soluble Oils.....*Clark W. Hathaway*
Discussion.....*T. R. Haseltine*
Dephenolizing of Wastes by Continuous Countercurrent Solvent Extraction.....*H. R. Kaiser*

Courses in Radioactivity for Waterworks Personnel

In recognition of the increased use of radiation and the associated health protection problems, the Public Health Service, U. S. Department of Health, Education, and Welfare, sponsors a radiological health training program. The purpose of the program is to indoctrinate public health workers with the significance of ionizing radiations, the environmental and occupational hazards attendant on their use, and recommended procedures for minimizing such hazards.

The training program is presented at the Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio. It is designed primarily for professional personnel of State and local health departments, but a limited number of qualified applicants from other governmental agencies and industry will be welcome.

The following courses are among those being presented in 1954-55 which may be of interest to the readers of *Water & Sewage Works:* "PROBLEMS OF RADIOACTIVITY IN WATERWORKS," to be presented November 1-5, 1954, and May 16-20, 1955.

For further information address: Chief, Radiological Health Training Section, Robert A. Taft Sanitary Engineering Center, 4676 Columbia Parkway, Cincinnati 26, Ohio.

Water Pollution's *Rule of Three*

How to calculate the proportionality in pollution due to oxygen demand or to bacterial load

by GUNNAR AKERLINDH, Consulting Engineer, Djursholm (Stockholm), Sweden

THE purpose of this paper is to emphasize the existence of a proportionality in water pollution. Studies reported here show how the oxygen deficiency or the bacterial density in polluted water (flowing or static) may be directly proportional to the added load of oxygen demand or of bacteria. Discussion of this subject properly begins with consideration of the oxygen sag formula; an expansion of that formula is presented which takes account of immediate oxygen demand as well as of the demand from sludge deposits.

The Oxygen Sag Formula

The variation of dissolved oxygen content in a polluted stream due to reduction of oxygen demand and to reaeration, the latter assumed as the main source of oxygen supply, may be calculated[9] according to Eq. (1) where:

D=oxygen saturation deficiency in the stream (ppm).
D_a=D initial (at time t=0).
L_i=initial immediate oxygen demand in the stream (ppm).
L_b=initial biochemical oxygen demand in the stream (ppm) due to "flowing pollution load"; that is, due to dissolved matter and non-depositing suspended matter.
L_a=biochemical oxygen demand in the stream (ppm) due to "depositing pollution load"; that is, due to the part of pollutional matter which settles to the bottom.
k_i=specific rate coefficient of deoxygenation due to L_i.
k_b=specific rate coefficient of deoxygenation due to L_b.
k_a=specific rate coefficient of deoxygenation due to L_a.
k_r=specific rate coefficient of reaeration.
t=time of flow (days).

Of the terms in the right member of this formula, the first takes account of the influence of the immediate oxygen demand[19]; the second, of the biochemical oxygen demand of non-depositing solids; and the fourth, of the initial oxygen saturation deficiency. Together they constitute the well known equation for the "oxygen sag curve"[22, 29]. The third term takes account of the oxygen demand of the *bottom sludge* ("depositing pollution load"). This term has been deduced[21] under the assumption that: first, the deposition of sludge in the stream follows a course similar to that in a sedimentation tank (that is, according to the "Imhoff sedimentation curve"[16], and, second, that the resulting oxygen consumption in a state of equilibrium, at each increment of time, is equal to the B.O.D. of that part of the actually settling solids which is simultaneously deposited from a flowing unit volume of the stream[19].

The Rule of Three

The *rule of three* may be simply stated as "the method of finding the fourth term in a proportion where three terms are given."

Dr. Akerlindh here applies that method by devising an equation relating oxygen deficiency and bacterial density in a polluted water to the added load of oxygen demand and bacteria.

While the simplified equation is an approximation, it usually is sufficiently accurate because it takes into account the immediate oxygen demand as well as that from sludge deposits.

It should be observed that k_i and k_a are large in comparison with k_b and k_r (both k_i and k_a in general have a value greater than 5, in contrast to the values for k_b and k_r being a few tenths). Consequently $k_i/(k_i - k_r)$ and $k_a/(k_a - k_r)$ will approximately equal unity, and further, the expressions $e^{-k_i t}$ and $e^{-k_a t}$ will comparatively rapidly approach zero. This implies that Eq. (1) may be written in the form of Eq. (2).

Immediate Oxygen Demand

In Eq. (2) consideration is given to the immediate oxygen demand as well as to the oxygen demand of sludge deposits. This is an approximation, but usually one made sufficiently accurate by introducing into the equation (for the original "oxygen sag curve"), as initial oxygen deficiency, not only the value for D_a but also those for L_i and L_a[9]. In fact, it appears quite logical to introduce the effect of such intensive oxygen demands as a momentary increase of the oxygen deficiency. As far as the immediate oxygen demand is concerned, it may be obvious because the oxygen consumption is so fast that simultaneous reaeration may be neglected. It may be noted, however, that when sedimentation is of appreciable magnitude, it generally takes place during a relatively short time of flow (such as a few hours). Realizing this fact, it seems clear that reaeration, concurrent with oxygen consumption due to a sludge deposit, may be disregarded. It makes no difference whether the sedimentation occurs immediately after the sewage has been discharged, or later in a stream stretch of quiescent water.

Starting from a certain given value of permissible water pollution—expressed in terms of a minimum required dissolved oxygen content (or maximum allowable oxygen deficiency)—the permissible maximum pollution load may be solved from Eqs. (1) or (2), on a trial-and-error basis[28]. In principle, this procedure constitutes a means of converting certain data on oxygen deficiency, measured in the body of receiving water under certain given conditions (that is, the prevailing amount of pollution, runoff, and temperature) to data valid for other conditions[28]. As a rule, the "other conditions" are those considered characteristic (specific sewage treatment, specific low runoff, etc.). Accordingly, in order to give reliable results, the application of Eqs. (1) or (2) requires sufficient direct samplings of the stream, mainly in order to ascertain rate coefficients and primarily that of reaeration. Several procedures for facilitating this work have been developed[4, 9, 23, 28]. Particularly it may be mentioned that Streeter's nomographic solution[29] is applicable to solving Eq. (2). Attention may also be drawn to the fact that k_b in Eq. (2) may have a different value in the numerator of the fraction in the first term of the right member than in other places of the same equation[28].

It should be emphasized that this conversion should not involve too

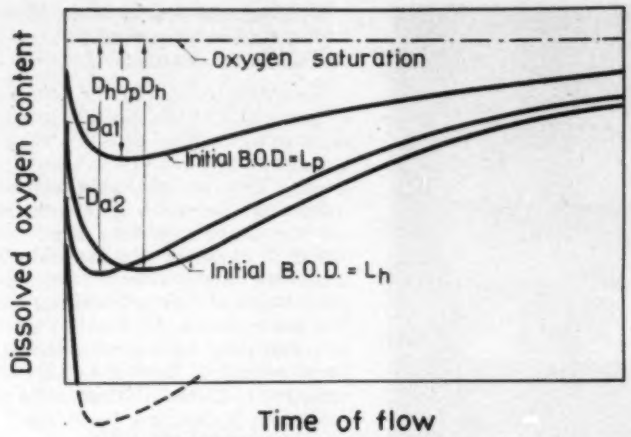


Fig. 1—DISSOLVED OXYGEN variation vs. time of flow (the "oxygen sag" curve)

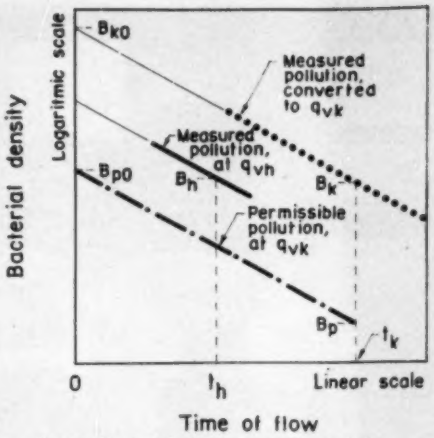


Fig. 2—Bacterial densities vs. time of flow

great changes in temperature or runoff. In other words, the stream samplings should be carried out at temperature and runoff conditions differing as little as possible from those termed characteristic.

If, however, the oxygen deficiency in a stream, particularly the maximum, is accurately determined and the pollution load causing this deficiency well known, then the related rather laborious procedure of calculation may be avoided and the permissible pollution load computed in a simpler way.

By derivation of Eqs. (1) or (2) and setting the derivative equal to zero, the maximum oxygen deficiency D_c, at time t_c (that is, at the critical point), caused by the total initial oxygen demand L_t, will become as shown in Eq. (3a) and (3b).

It may be noted that the same result may be obtained by setting the rate of deoxygenation equal to that of reaeration [7, 13].

Provided that the proportion between L_l, L_b and L_s remains constant, t_c becomes a function of D_a/L_t (or D_a/L_b). Derived from Eq. (2) the expression for t_c has the appearance of Eq. (4).

It is of particular importance that t_c may often be regarded as nearly constant. With $D_a=0$ or D_a/L_t (or D_a/L_b) constant, this is definitely the case according to Eq. (4). Further, with relatively low values of D_a, as well as with moderately changing values of D_a/L_t, the variation of t_c will be so small as to be neglected. That this condition will generally be fulfilled in practice may be understood by the fact that, if D_a is not small and thus not negligible, it will decrease (due to general pollution abatement) sooner or later after L_t has been reduced, and approximately in the same proportion.

EQUATIONS

$$D = \frac{k_l L_l}{k_r - k_l}(e^{-k_l t} - e^{-k_r t}) + \frac{k_b L_b}{k_r - k_b}(e^{-k_b t} - e^{-k_r t}) + \frac{k_s L_s}{k_r - k_s}(e^{-k_s t} - e^{-k_r t}) + D_a e^{-k_r t} \quad (1)$$

$$D = \frac{k_b L_b}{k_r - k_b}(e^{-k_b t} - e^{-k_r t}) + (D_a + L_l + L_s)e^{-k_r t} \quad (2)$$

$$D_c = \frac{L_t}{k_r}\left(k_l \frac{L_l}{L_t} e^{-k_l t_c} + k_b \frac{L_b}{L_t} e^{-k_b t_c} + k_s \frac{L_s}{L_t} e^{-k_s t_c}\right) \quad (3a)$$

$$D_c = \frac{k_b}{k_r} \cdot L_b e^{-k_b t_c} \quad (3b)$$

$$t_c = \frac{1}{k_r - k_b} \log_e \left\{ \frac{k_r}{k_b}\left[1 - \frac{k_r - k_b}{k_b}\left[\frac{D_a + L_l + L_s}{L_b} \right]\right]\right\} \quad (4)$$

Maximum Oxygen Deficiency

Returning to Eqs. (3a) and (3b), it is evident that, since t_c is approximately constant, the maximum oxygen deficiency, D_c, is a direct proportion to the total amount of added oxygen demand, L_t; providing that the composition of the pollution load remains unchanged. "Unchanged" means that, as mentioned above, L_l/L_t, L_b/L_t, and L_s/L_t remain constant proportions, the sum of these constants being equal to unity.

Furthermore, it can readily be shown from Eqs. (1) or (2) that, under the related conditions of unchanged composition and D_a/L_t approximately constant, D will become proportional to the added oxygen demand; not only at the cirtical point but also for any given value of time t.

Thus, knowing the oxygen deficiency D_h (at maximum or after a given time of flow), caused by a certain pollution load L_h, then the amount of the permissible pollution load L_p, may readily be computed for a given value of permissible oxygen deficiency D_p, through application of the *rule of three* according to Eq. (5).

It should be noted that attention previously has been drawn to this proportionality, particularly at the critical point[8, 13]. The condition was early observed by Streeter, who has tested it against observations in a number of

Fig. 3—LABORATORY SETUP for bacterial pollution investigations
Four tubs used for study of repeated addition of pollution
Four beakers used for study of momentary pollution

rivers, including the Ohio and Illinois. In a letter to the author in August 1950 he stated that, in American rivers, the proportionality "should hold fairly well under summer low-flow conditions, which of course are the most critical."

It must be emphasized, however, that a change in the amount of added pollution may shift its composition to such an extent that the specified condition concerning unchanged composition of the pollution load may not be satisfactorily fulfilled. This could be the case when sedimentation alone is used for sewage treatment. Under such circumstances a calculation according to Eqs. (1) or (2) may be necessary. In many cases, however, the application of Eq. (5) has considerable advantages[4, 6], at least in order to lend lucidity to the calculations. Often the most suitable and convenient procedure is: first, to convert the primary data from the examination of the stream to make them valid for a pollution load of approximately the same relative composition as the one to be expected after introduction of treatment (as well as to the desired temperature); and secondly, to determine the permissible pollution load according to Eq. (5).

The conversion to a different composition requires, as mentioned above, a thorough investigation of the stream, particularly in order to establish the oxygen balance at various points. In certain cases it may even be possible on this basis to estimate the negative oxygen content—that is, the oxygen deficiency exceeding the value of oxygen saturation (see Fig. 1)—which according to the formula occasionally theoretically would prevail. A suitable method applicable for this purpose has been described[19].

Bacterial Death Rate

Due to the effect of self-purification in a polluted stream, the variation in coliform bacterial density versus time has been found to have a fairly regular course[1, 10, 17, 18]. A short increase to maximum is followed by a decrease which, in a semi-logarithmic diagram, has been found to have approximately the form of a straight line; or, possibly, the form may be expressed as the sum of two or more straight lines intersecting to form wide angles. The diminishing part of the curve ("the death rate curve") is closely satisfied by an exponential equation such as Eq. (6) or (7).

In these equations:

B = bacterial density in the stream (coliforms per ml.)

A and k are constants.

According to Eq. (6), the reduction of bacteria is at each instant proportional to the residual density (temperature and other conditions being constant). This is only approximately correct, and several other expressions for the death rate have been published[14, 18]. However, the deviation becomes substantial after a rather considerable time. For practical purposes it is sufficient to apply Eq. (6) which, as pointed out by several authors, is likely to have a time of validity (in summer) of around 100 hours. In any case, even if this time be shorter[18], it seems a general rule that in a temperate climate during the summer, the bacterial density will decrease, during the time of validity for Eq. (6) to a magnitude of one or two per cent of the maximum value[1, 10, 16, 17, 18].

Bacterial Pollution Density

In Eq. (6), the constant A may be considered as representing the density of pollution at the point of maximum. Evidence exists that this maximum density is proportional to the initial water pollution at the point of discharge for example, (see Fig. 4). This latter density in turn is proportional to the contributed amount of bacteria. Further, in Eq. (6), for a given value of t, the expression 10^{-kt} is a constant. Thus, the bacterial density in a stream after a given time of flow—that is, at a specific point at a certain runoff—will be a direct proportion to the amount of bacteria contributed at the point of discharge. Let b_o denote this

EQUATIONS

$$L_p = L_h \frac{D_p}{D_h} \qquad (5)$$

$$B = A.10^{-kt} \qquad (6)$$

$$B = A_1.10^{-k_1 t} + A_2.10^{-k_2 t} + \ldots \qquad (7)$$

$$B = C\frac{b_0}{q} \qquad (8a)$$

$$B = c.B_0 \qquad (8b)$$

$$\frac{B_{p0}}{B_{k0}} = \frac{B_p}{B_k} \qquad (9)$$

$$k_r D = L_1 + L_b + L_s \qquad (10)$$

$$D = \frac{L_t}{k_r}\left[\frac{L_1}{L_t} + \frac{L_b}{L_t} + \frac{L_s}{L_t}\right] \qquad (11)$$

$$B = \int_0^\infty A.10^{-kt}.dt = \frac{A}{k}\log e = 0.434\frac{A}{k} \qquad (12)$$

added amount of bacteria; q the flow in the receiving stream, (including sewage discharges); B_o the initial density in the stream; and c the constant. Hence, with thorough mixing provided, suppose that Eq. (8a) or (8b) applies.

Application of the *rule of three* according to Eq. (8b) offers a convenient way to carry through calculations of bacterial pollution, in order to determine the permissible pollution load. It should be noted, however, that if sufficient accuracy is to be obtained in this case, it is necessary that the calculations are based on results from thorough samplings of the stream.

The Effect of Variation in Runoff

It often has been pointed out that stream sampling should be carried out at times when the runoff is rather steady and also when it is as closely as possible equal to that value of runoff for which the permissible pollution load is to be calculated. Under such conditions, the difference in size between the runoff value prevailing at sampling and the runoff value used in the calculations will not involve any particular complication as far as calculations of oxygen deficiency are concerned.

Regarding calculations of bacterial pollution, however, such a difference in runoff may have an effect of importance, as illustrated in Fig. 2. The full line represents the course of measured density at sampling runoff q_h. At calculation runoff q_k, the pollution is changed in the ratio q_h/q_k to the dotted line, with a displacement in time corresponding to the changed rate of flow (assuming approximately constant temperature). The measured pollution B_h at a certain point, and at a certain time of flow t_h at sampling runoff, takes for the calculation runoff and its corresponding time of flow t_k, the value B_k. The permissible density at the point under consideration being B_p, then the required ratio between permissible and prevailing initial pollution (at point 0, see Fig. 2) is given in Eq. (9).

Oxygen Deficiency of Lake Water

The pollution of water in a lake takes place in a somewhat different way than is the case in a stream. In the latter instance, *momentary water pollution* may be considered to occur, that is, a given volume of water becomes polluted once, but no more, from a certain point of discharge. In the case of a lake, however, *continuous water pollution* (or repeated pollution) may prevail; that is, a given volume of water becomes polluted more or less continuously from a certain point of discharge.

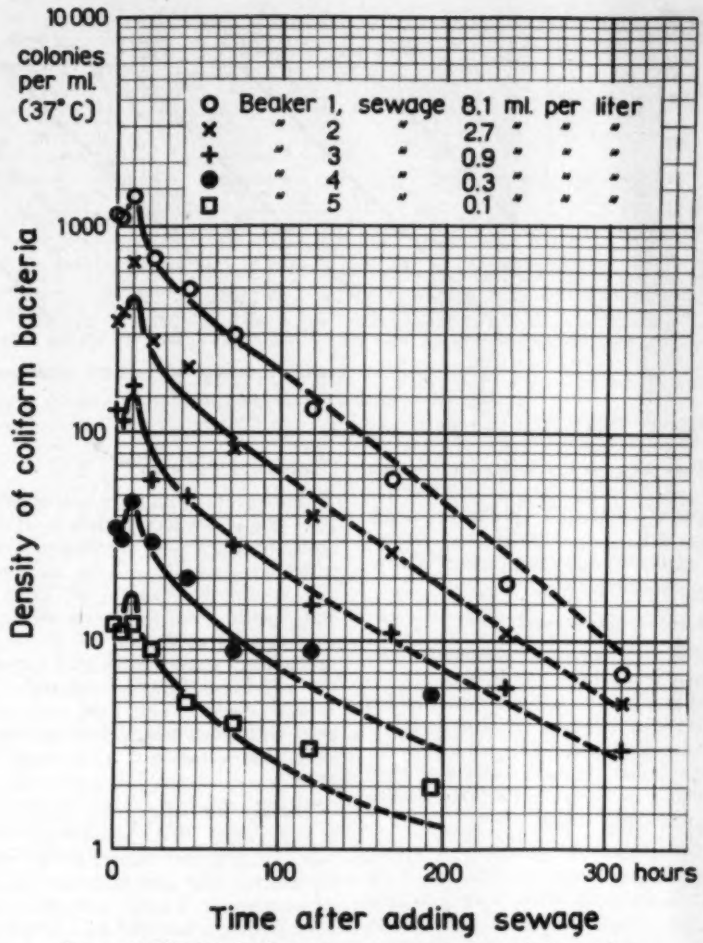


Fig. 4—BACTERIAL death rate curves in momentary pollution studies

It is obvious—and may readily be shown mathematically[8]—that, assuming rather steady conditions, the concentration of pollution (for example, of B.O.D. or bacteria) in a lake tends to approach a state of equilibrium. Under such conditions the consumption of oxygen becomes equal, for each interval of time, to the supply of pollution[35]. The rate of pollution addition may be written $L_t = L_l + L_b + L_s$. Since the rate of atmospheric reaeration[10] equals $k_r D_r$, then Eq. (10) and (11) will apply.

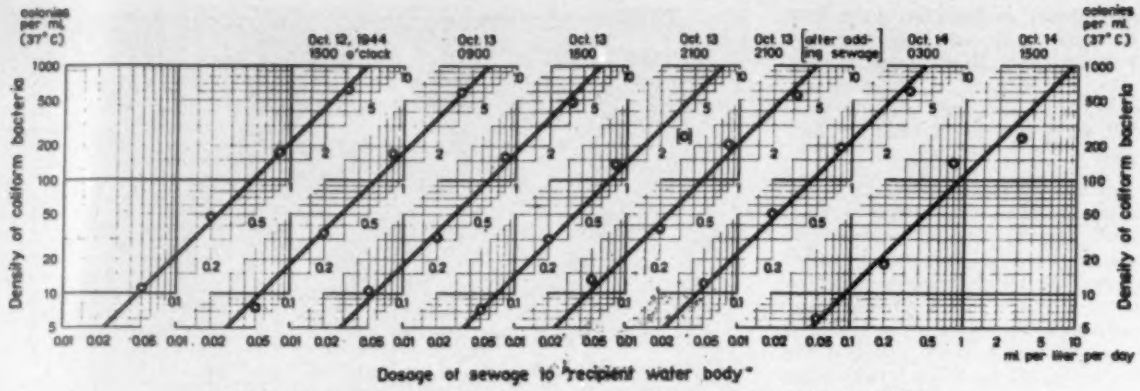
According to Eq. (11) the resulting oxygen deficiency in a lake (at a state of equilibrium) is in direct proportion to the amount of added pollution, assuming constant composition of the pollution and atmospheric reaeration as the only source of oxygen supply.

Bacterial Density in Lake Water

Suppose that the bacteria contributing continuously (or repeatedly) to a certain volume of water, as is regarded to be the case in a lake, should die away in the same manner as in momentary water pollution. Then, after a state of equilibrium is attained, each point on the curve according to Eq. (6) should be represented in the lake water. The resulting bacterial density, assuming complete mixing, should thus be equal to the integral with respect to time of that same function from t=0 to t=∞. Hence, Eq. (12) will apply.

Since, as before, A is a direct proportion to the contribution of bacteria, Eqs. (8a) and (8b) also should be valid in this case. Thus, with the stated assumption concerning the death rate, the resulting bacterial density in a lake would be proportional to the added amount of bacteria (per unit of time).

While this reasoning sounds plausible, no evidence seems to be present that death in an accumulated mass of bacteria should follow a course in accordance with Eq. (12). Therefore, the stated proportionality concerning bacterial density in a lake needs


colonies per ml. (37° C)
Density of coliform bacteria
Oct. 12, 1944 1500 o'clock
Oct. 13 0900
Oct. 13 1500
Oct. 13 2100
Oct. 13 2100 [after addition sewage]
Oct. 14 0300
Oct. 14 1500
Dosage of sewage to "recipient water body"
ml per liter per day

5—BACTERIAL densities at specific time intervals in studies of repeated pollution addition
Doses (constant for each tub) were 0.05, 0.2, 0.8, and 3.2 ml of sewage per liter of water per day

further support before it can be made a basis for calculations of, for instance, permissible pollution load. This lack of knowledge has caused the author to carry out certain laboratory experiments.

Laboratory Experiments

The laboratory experiments, designed to evaluate the hypothesis regarding proportionality between added bacteria and the bacterial density resulting from continuous (or repeated) water pollution, have been described in detail by the author[3]. They will be reported only briefly here.

A number of similar "receiving water bodies" were provided by filling several tubs with water from a natural stream (Fig. 3). Amounts of sewage, substantially of domestic character, were repeatedly added to these tubs over a certain period of time, the added amount being constant for each tub but varying from one tub to another. After sufficient time to attain an approximate equilibrium between pollution addition and self-purification, samples were taken of the bacterial density in these "receiving waters."

As the right to draw practical conclusions from results thus obtained under laboratory conditions might be doubtful, other experiments were carried through simultaneously in accordance with the following reasoning. If laboratory experiments representing momentary water pollution (that is, with only one single dose of pollution added) give results similar to those reached under natural conditions, then it should be proper to draw limited conclusions from the main experiments concerning repeated pollution. Also, so far as bacterial densities are concerned, the analogy between laboratory experiments and natural conditions may already be considered as proved[10].

Continuous Pollution

The experiments were performed in 1944 at a laboratory with normal daylight. In studies of continuous water pollution, four enamel tubs, each initially containing exactly 10 liters of water were used, as shown in Fig. 3. The original pollution of the water was comparatively weak, and the sample had been allowed to stabilize for several weeks. The tubs were covered with glass plates, both to reduce evaporation and pollution from the air.

During the first week, dosages of sewage were added at 24-hour intervals; during the second week, every 12 hours. For the last days of the experiments, 6-hour intervals had been planned, but this was found too difficult to carry through with the limited resources available. The sewage was added from a pipette, the dose being spread as evenly as possible over the whole surface, and afterwards the water was stirred carefully. The proportions of sewage were 1:4:16:64. The amounts of sewage added, as well as the time intervals for its addition are shown in Fig. 6. This chart illustrates the points of time for sampling (always from three different places in the water), and how they were grouped around the last dosages, particularly the final one.

Momentary Pollution

For the experiments planned to correspond to momentary water pollution, five enamel beakers were used (in Fig. 3 only four are seen), each one containing exactly one liter of water. One single dose of sewage was added to each one of these, in the proportions 1:3:9:27:81. Samples were taken after 0, 4, 10, 22, 44, 72, etc. hours (see Fig. 4).

The sewage was taken from a trunk sewer, in which the flow was almost exclusively domestic sewage. At the laboratory it was aerated and allowed to stand for 15 minutes, after which a sample was removed by siphon and filtered through cotton. The filtered sewage was used for dosing the water samples. Due to this treatment of the sewage there was little visible pollution in the "receiving waters." Only in the most polluted samples was some sedimentation evident at the end of the period, apparently as a result of biological flocculation.

The temperature of the water was about 20° C during the experiment.

The determination of the density of coliform bacteria was carried out by counting the number of colonies developed on "congo agar" after 24 hours of incubation at 37° C. Congo agar is 3 per cent nutrient agar containing lactose and congo red, the latter as an indicator of acid formation. This method is widely used in Sweden and, according to general experience, the average results obtained agree closely with those obtained by the fermentation tube test. In comparison with the latter, plate counting has the advantage of less spreading of the observations. In these bacterial determinations the coli-aerogenes group was regarded as represented by all colonies having a definite dark-violet color. At least two, sometimes three, plates were prepared from each sampling.

The results of the experiments concerning momentary water pollution are shown in Fig. 4. It is evident that the decrease in bacterial density has approximately the same course as may be considered normal for a natural stream. Furthermore, these curves help confirm the existence of a proportionality between bacterial contribution and resulting density during a three to four day period. Beyond this time, however, the curves show a tendency to run together.

The bacterial densities of the water in the tubs (repeated water pollution study) are marked as mean values in Fig. 5 on a double logarithmic scale.

These values, if lending support to the assumed proportionaliy, should for each sampling period, group themselves around a 45-degree line (since $y = k.x$ corresponds to $\log y = \log k + \log x$). Such lines are drawn in Fig. 5.

It might appear a tendency for the points which represent lowest addition of pollution to lie preponderately to the left of the lines, and those which represent highest pollution concentration to lie to the right. However, taking into account the data lying between, it has not been considered justifiable to abandon the 45-degree slope of the line or to select any other kind of curve.

Discussion

These experiments seem to lend substantial support to the stated hypothesis; that is, to the existence of a proportionality between bacterial load and resulting density at continuous water pollution. It is true that they in no way constitute an exhaustive undertaking but only a limited one. The experiments cover only a certain range of bacterial water pollution, and no regard is taken to the effect of bottom sludge. However, the range studied, extending from some few up to about one thousand coliform bacteria per milliliter, should be of particular importance. Therefore, even if complete confirmation has not been attained, it seems that considerable evidence has been presented for the validity of the assumed proportionality.

Finally, it should be noted that the experiments described have not succeeded in confirming the condition which forms the basis for Eq. (12), that the total bacterial density should correspond to the integral of the function representing the death rate curve at momentary water pollution. The calculated densities always were considerably higher—five to eight times—than those actually determined. Various explanations may be given to this difference; such as that the self-purification agencies in the tubs should have had more time to adapt themselves to the prevailing conditions than those in the beakers, or that the death rate should depend on more factors than the remaining concentration (at a given temperature). However, these laboratory studies seem to furnish too limited a basis for a further examination of the question.

Summary

The paper seeks to draw attention to the fact that many calculations concerning water pollution, designed to determine the permissible pollution load, could be satisfactorily solved by the application of the *rule of three*. A necessary condition is, as ought to be the case in all calculations of water pollution, that data from representative sampling of the water body in question must be available.

In order to lend further support to the applicability of the *rule of three* to calculations of water pollution, certain laboratory experiments have been carried through and are described in the paper.

It is not claimed that a proportionality always exists between the added pollution load and the resulting degree of water pollution. The intention is, however, to demonstrate that such a proportionality prevails, at least approximately, under certain assumptions which may very often be considered as fulfilled. In special cases a preparatory conversion of the values obtained from the investigation of the polluted water body will be required.

In connection with the discussion of the proportionality in water pollution the paper presents an expansion of the oxygen sag formula (see Eq. 2), in which account is taken of immediate oxygen demand, as well as of oxygen demand from sludge deposits, by adding the values of these demands to the value of the initial oxygen depletion.

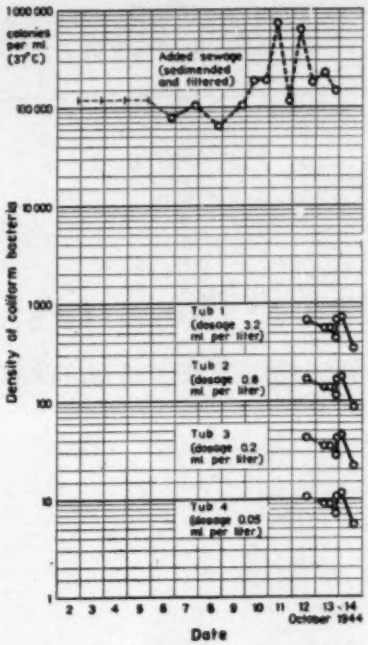

1 000 000
colonies per ml (37°C)
100 000
10 000
1000
100
10
1
Density of coliform bacteria
Added sewage (sedimended and filtered)
Tub 1 (dosage 3.2 ml per liter)
Tub 2 (dosage 0.8 ml per liter)
Tub 3 (dosage 0.2 ml per liter)
Tub 4 (dosage 0.05 ml per liter)
1 2 3 4 5 6 7 8 9 10 11 12 13 14
October 1944
Date

Fig. 6—COLIFORM densities in studies of repeated pollution addition

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REPORT FROM ABROAD

Highlights of the British Institute's 1954 Sewage Purification Conference

by **JOHN FINCH,** ***Manager, Sewage Disposal Department***
Rotherham, England

THE 1954 Conference of The Institute of Sewage Purification has come and gone, but it has left major impressions on the minds of the 650 delegates who attended. In particular it has left a deeply-etched impression relating to certain ramifications of the activated sludge process of sewage treatment emphasized during the course of the Conference.

This year's Conference "highlights" included discussions of the predicted and rather surprising trends of the activated sludge process; and also the reactions of the Manchester Rivers Department, with such implications as may be placed on these, to the various activated sludge processes.

Activated Sludge—40th Anniversary

The year 1954 being the 40th anniversary of the classical paper by E. Arden and W. T. Lockett entitled "Experiments on the Oxidation of Sewage without the Aid of Filters," it was decided to celebrate the occasion by doing honor to the surviving member of this famous pair of workers, Mr. W. T. Lockett.

The Conference took the form of a symposium on "The Evolution and Development of the Activated Sludge Process of Sewage Treatment in Great Britain," and nine contributions were presented covering the entire range of proved developments: diffused air, bio-aeration and Simplex surface aeration. Of the nine contributions, one of great value was a reprint published by permission of the Council of the Society of Chemical Industry. I plan to discuss in future reports certain of these contributions on various aspects of the activated sludge process.

President—Dr. Arthur Key

Dr. Arthur Key, senior chemical inspector to the British Ministry of Housing and Local Government, was installed as President of the Institute during the Conference.

Visitor to Britain
W. H. Wisely
Exec. Secy.-Editor
F.S. & I.W.A.

Dr. Key will be remembered in the United States by many workers in the sewage treatment field who met him during the course of his visit there some two or three years ago; he was a member of the O.E.E.C. group studying sewage treatment practice in the U.S.

In his presidential address, Dr. Key surveyed the problems of sewage and industrial waste treatment, of river board standards, etc., and held his audience from beginning to end. He concluded by saying:

"The future will be a difficult time, possible a dangerous time, but certainly an interesting time. We of this Institute will not die of boredom. We may wear out, but we won't rust out. We stand as a barrier between two sets of people, those who have used water and put all kinds of other materials into it and those who still need water free from those materials. Our job is to protect civilization from one great danger of civilization . . . a noble and worthwhile task."

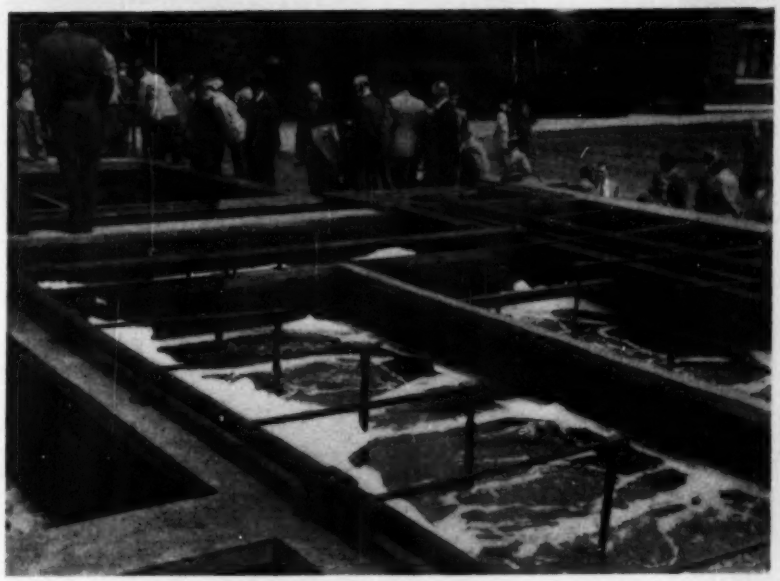
The conclusion to his address is of universal application in the sewage treatment field. It might well be applied to the Federation as an international charter of the aims and objects of the F.S. & I.W.A. in combatting pollution of the rivers and waterways of the world.

Honored Guest—W. H. Wisely

One of the undoubted highlights of the Conference proceedings, and one which I enjoyed perhaps more than any other contribution, was the address by William H. Wisely, Secretary of the Federation of Sewage and Industrial Wastes Associations. A more polished or sincere contribution to the Institute of Sewage Purifications' proceedings is not easy to imagine. In his address, Mr. Wisely not only made his official introduction from the platform to members of the Institute and to delegates from overseas; but, of equal importance, made an introduction that caused him to be warmly taken up by every delegate to the Conference.

Mr. Wisely was exceptionally well received officially in Conference, and as well received socially on the floor of the Hall during the recess. He has that particular charm of character of being essentially a friendly man; he made friends with many delegates, and was whole-heartedly accepted as one of them. Without any doubt his visit to Blackpool was an unqualified success. I hope that he and men like him will continue to come to these meetings and refresh us with their personalities and their knowledge of the art of sewage treatment.

In his address, Mr. Wisely gave us some idea of the problems confronting U. S. sewage treatment authorities. He specifically mentioned synthetic detergents, which, of course, are also a thorn in the side of the sewage treatment plant worker in Great Britain. His discussion of trends in the U. S., and of the status of the Federation members, really had listeners keenly interested.



WITHINGTON treatment works—home of activated sludge

Top—Early research was conducted in this building
Below—Original diffused air activated sludge units

British Pioneer—W. T. Lockett

Mr. W. T. Lockett was given the honor of presenting on behalf of the various authors—six of whom are Past-Presidents of the Institute—all the symposium papers relating to the evolution and development of the activated sludge process in Great Britain. At a later stage in the proceedings, the individual authors made additional introductory comment on their contributions.

While sewage treatment plant workers occasionally take their pleasures in unusual places, they still may have an eye for business: for example: a certain Mr. Jos. Bolton, the originator of the Simplex aerator, had his inspiration which resulted in the design of his aerating cone as a result of seeing some mechanism whilst visiting the Blackpool Pleasure Beach a good number of years ago!

The discussion of any paper is always the thing that matters most. Discussion of this massive array of technical literature, which might be termed "A Modern History of the Activated Sludge Process," was no exception to the rule.

Mr. C. B. Townend of Mogden, West Middlesex, paid a very handsome tribute to American workers in the field for their advances in the development of the activated sludge process. He subscribed to a philosophy of vigorous aeration in the treatment units, to provide the best conditions for best output; he said that it was possible to economize in air in the aeration unit beyond the limits of really true economy, and he had many supporters to his theories.

Another delegate made the point that partial treatment by the activated sludge process represented the maximum B.O.D. removal per unit of money expended, and added that in Germany the percolating filter was giving way to the activated sludge process with the adoption of coarse bubble aeration more than a possibility. Mr. Fillingham Brown commented that for a time the activated sludge plant at Colne Valley had been operated with 10,000 ppm of suspended solids in the mixed liquor, using an air consumption of about 2 cubic feet per gallon of sewage treated. He thought that there were unexplored possibilities in this method of operation.

Future Developments

As previously stated, certain very deep impressions were made on the minds of delegates during the course of the discussions—especially by the statements on future trends which several authorities predicted.

Various delegates, including Messrs. Wisely, Jenkins (Birmingham Tame & Rea District Board) Lockett (West Middlesex), McNicholas (Manchester), Townend

DAVYHULME activated sludge plant of the Manchester Rivers Department

Top—Diffused air treatment plant, capacity 16 mgd

Center—Bio-areation plant units, capacity 0.6 mgd

Below—Surface aeration plant, capacity 1.0 mgd

(West Middlesex), etc., summarized opinions which indicate the activated sludge plant of the future may have some or all of the following features:

1. Units designed to treat raw screened sewage.
2. Facilities for return of very large volumes of sludge.
3. Provision for intensified aeration.
4. Capacity to use much higher solids concentration in mixed liquor.

In the opinion of Mr. Lockett, the future of the activated sludge process is intimately concerned with the problem of satisfactorily de-watering the surplus activated sludge. I think that there is no doubt that in Great Britain, and particularly in the North, the satisfactory dewatering of activated sludge is still a problem, with authorities beginning to lean a little towards heat-treatment processes and mechanical means of dewatering.

Birthplace of Activated Sludge

The visit planned to the Withington and Davyhulme sewage treatment works of the Manchester Rivers Department—the home of the activated sludge process—was a major event of the Conference. Considerable interest was shown in the Withington sewage treatment plant, particularly by overseas visitors, on account of the fact that in 1917 the first diffused air activated sludge plant was installed on this site. Cameras were much in evidence, recording data relating to this original diffused air plant which even today is doing a fair job of purification.

The population draining to the Davyhulme works, around 820,000 persons, produces an average daily flow of about 55 million gallons—or a rate of flow of 67 gallons per capita per day. The original works, which came into operation in 1894, were designed for the treatment of sewage by chemical precipitation.

The activated sludge plant now approaching 20 years of age comprises a 16 mgd diffused air plant, a 0.6 mgd bio-aeration plant and a 1.0 mgd Simplex surface aeration plant. The diffused air plant has a detention period of 14 hours dry weather flow and covers an area of 21,200 square yards. The bio-aeration plant has a detention period of 18 hours and covers an area of 2,900 square yards. The Simplex aeration plant has a detention

period of 15.5 hours and covers an area of 2,050 square yards.

During the last 3 or 4 years increasing difficulty has been experienced in maintaining satisfactory effluents from these plants, particularly those units employing diffused air. The Manchester authorities state that there is reason to believe the rate of solution of oxygen from air bubbles is reduced in the presence of synthetic detergents; these new materials are to a large extent considered to cause the trouble.

In the existing diffused air plant, three lines of diffusers are laid longitudinally in the 15-foot channels with a transverse line located at 45-foot intervals placed at the foot of a baffle wall under which the mixed liquor must pass. The air diffusers originally installed were flat porous plates, but as each unit becomes due for overhaul, the plates are being replaced by the latest dome-shaped type. The new type has had a somewhat mixed reception since its development a few years ago. The engineer of the Colne Valley Sewage Scheme has stated that he considers the dome-type diffusers to be no better than the porous plate.

A New Aeration Unit

Incidentally, it was learned during the course of discussion at the Conference that the Manchester Rivers Department is considering the installation of yet one more type of activated sludge plant; this is to be in the form of a Kessener Brush unit.

The three existing plants have been installed and operated on a comparative basis for 20 years or so without a decision being made as to which is the best scheme to suit the Manchester conditions. It would appear that the Manchester authorities have insufficient faith in any of the existing activated sludge schemes to justify their adopting one of the systems on a large scale for their impending extensions.

It is not easy to visualize the Kessener Brush unit succeeding where the other schemes have failed—if it is accepted that the other three schemes have in fact not been successful—although in Europe one or two pilot plant Kessener Brush schemes are reputedly operating at the moment with a very high degree of efficiency. However, should Manchester make the decision to install a Kessener Brush plant of modern design it will be of considerable interest to study the performance of such a plant in treating the difficult Manchester sewage.

Special Feature

An unusual feature of the visit to Davyhulme was the wonderfully attractive color of what is now accepted in the various activated sludge plants as conventional detergent-produced foam. Over the past year or so I have seen dirty white foam in abundance; snowy white foam in even greater abundance; but never before have I seen such beautiful purple foam as exists at Davyhulme. However, the opinion of delegates appeared to be that even the production of foam "in glorious technicolor" would still have no appeal to those sorely tried authorities battling with this irritating problem!

W&SW

Cleary Honored by Award of Inter-American San. Eng. Assn.

Edward J. Cleary, executive director of the Ohio River Valley Water Sanitation Commission, with headquarters in Cincinnati, has recently been awarded the Hemispheric Sanitary Engineering Award of the Inter-American Association of Sanitary Engineering. Mr. Cleary was president of the organization in 1953.

The award was made for his work in organizing and then in reorganizing the association, and for technical papers which he presented, at a number of conferences last year. The organization brings together sanitary engineers of South America and the United States.

In the Spring of 1954 Mr. Cleary spent five weeks in Europe, under auspices of the World Health Organization and the Rockefeller Foundation. He studied water pollution problems in several countries, and participated in a conference bringing 21 nations together to exchange information on health problems.

Others receiving awards of the Inter-American Association were Col. Donald Snow, U. S. Public Health Service; Ralph Vanderwecker, Chief Sanitary Engineer, Coast Guard, and Miss Dinorah Lopez-Molina, Pan-American Sanitary Bureau.

W&T Signs Consent Judgment Ending U. S. Antitrust Action

Wallace & Tiernan Incorporated, on July 26, in Providence, R. I., signed a Consent Judgment ending an action brought by the Department of Justice on November 18, 1946. Simultaneously a companion criminal case against the Company was terminated with the entry of *nolo contendere* pleas and the assessment of fines. These were among the oldest antitrust cases on the docket of the Department.

While the Judgment imposes certain restrictions upon the business operations of the Company, management stated that, aside from the merits of the case, settlement by this Judgment will be less burdensome to the Company than a protracted trial with its attendant costs and diversion of executive time and attention.

The Judgment relates only to the Company's domestic chlorination business in the sanitary field—largely municipal water and sewage treatment plants and swimming pools—which business accounts for approximately 15% of the consolidated corporate revenue. Its important feature is the requirement that where engineering services are furnished in larger prospective installations, the Company notify certain competitors of the fact. Other provisions deal with the Company's activities in trade and technical associations and others spell out rules covered generally in existing antitrust legislation.

The Wallace & Tiernan management considers the Judgment to represent a reasonable method of resolving the differences existing between it and the Government.

True Enough: Money can't always buy happiness, but a little of it places the possessor in an excellent bargaining position.

A Meter Test Program May Surprise You!

An Open Letter from One Water Works Man to Another

Dear Bill,

I got to thinking about the letter I wrote you on 100 per cent metering. One big reason for complete metering is to reduce consumption. That's a big item where water is as short as it is in so many places now. As so often happens, when you solve one problem you create another, and meter installation creates another problem that we superintendents must face squarely—meter maintenance and replacement.

We all know that you can only be sure for a few years that meters record accurately. Then they need to be checked, often repaired and sometimes replaced. I am certain that many of us, when we put in a new meter, smile to ourselves and think, "I don't have to worry about that account any more, they'll be charged for all the water they use from now on." It's too bad, but that is not always the case. The meter does record accurately for some years, then maybe it slows down or even sticks. If this happens throughout the district the "unaccounted for" water goes up and up and so does consumption.

Stuck meters aren't too much of a problem since either the meter reader or the billing clerk will probably notice the low consumption and direct the service men to check the meter and replace it if necessary. It is the SLOW meters that are the real problem.

Our water district has about 7000 meters in the ⅝-in. size, including American, Badger, Crown, Empire, Federal, Lambert, Nash, Trident, and Worthington-Gamon. With all this variety, you can see that I have had to stock a lot of parts. About this time last year, I began considering a scheduled repair and replacement program. As I began looking into the condition of the meters in the district I found some as old as 30 years and many over the ten year mark.

I picked the ten year date after consulting the AWWA Specification C700-46 which recommends that ⅝-in. meters should be changed every ten years, regardless of make. (Larger meters should be changed even more often according to the AWWA.)

We Bought a 10-Meter Test Bench

A new meter test bench was purchased so that the repair man could test ten meters in the same time that was previously required to test one. All meters removed are now tested when brought in to the shop for any reason at all. When this bench was in operation I inaugurated a meter replacement program on a pilot scale to determine whether a full scale replacement program was necessary. I selected 141 meters, all different types, ranging in age from 10 to 30 years, to be replaced and tested. Considering their age, I guess I shouldn't have been too surprised to find that they (all makes) averaged 44.2 per cent slow.

This percentage needs some explanation. The meters are tested at four rates of flow, 14 gpm, 4 gpm, 1 gpm, and ¼ gpm. At the three higher rates one cubic foot is run through the meter, at the ¼ gpm rate only one-tenth of a cubic foot is used. A per cent fast or slow is obtained for each rate. While some people estimate that as high as 17 per cent of the water is used at the ¼ gpm rate, I estimate that 95 per cent of the water used in our system is used at less than the 4 gpm rate. Therefore, I calculated the average per cent slow (44.2%) on the 1 gpm tests.

Another factor is important here. A stuck meter is, of course, 100 per cent slow, but it may only stick at or below the one gpm rate. Many meters were found to be either accurate, fast, or slow at the 14 and 4 gpm rates but would stick at the one gpm rate, thus giving zero registration. These were tabulated as 100 per cent slow.

We Are Out $10,000

Assuming the annual revenue through a ⅝-in. meter to be $32 per year and based on the average per cent slow, the annual loss on each slow meter was $14. At this rate only changing 141 meters would result in an annual increase in revenue of about $2000. If these meters had been changed after ten years of service, we would have had about $10,000 additional water revenue.

The results of this pilot scale program have convinced me that a full scale program should be inaugurated. I have set as a target to have all of the meters over ten years old replaced by the end of this year. When that is done I'll determine the economic life of each make of meter as indicated by our testing. This may be nine years for some makes, 10, 11, or 12 years for others, and the meters will be regularly replaced on that schedule. Of course, if there is any indication that the meter is inaccurate before that period ends, we'll bring it in and replace it.

In order to take care of the backlog that we have at the present time I have one man working about half time replacing meters, as well as a full time man testing and repairing. I use the replacement program to help balance our work schedule; when work is light, meters are replaced; when the load is heavy, the program is skipped for a while. It works out to about one man working half time.

In the first six months of this year we have accomplished about one-half of this year's job and we have already replaced 301 meters of all makes. Doubling this figure and adding the 141 we replaced last year shows that we had about 750 meters of the ⅝ in. size older than ten years, or about 10 per cent of all the meters in the district. Just goes to show you how a thing like this can sneak up on you if you're not careful.

Generally, we repair inaccurate meters and put them back into service, but we are retiring obsolete makes and replacing them with only two well known makes. This will help standardize the district and should make life a good deal happier for all concerned in the future—save, possibly, those customers who have been getting a lot of free water.

You can't miss with a program like this. Not only do you reduce your "unaccounted for" water and increase revenue, but it will result in better customer relations. In the past, when a slow meter was replaced with an accurate one, the customer frequently complained about the sudden increase in his water bill. This involved some placating and some explanation that the customer had been getting part of his water for nothing. I'm glad we've started a regular program of meter replacement here; but, was I "rebarrassed" when the truth became known.

Yours, Jim

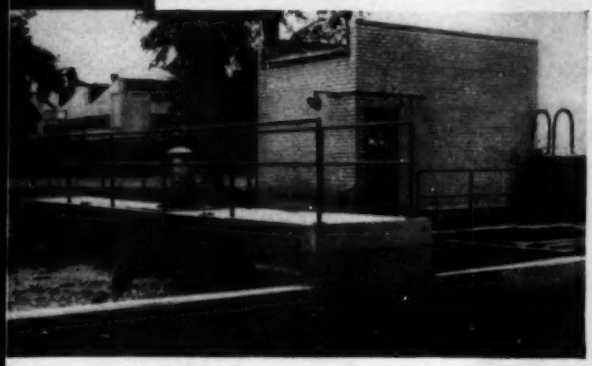
Ed. Note: Our friend "Jim" is actually George H. Straub, Supt., Westchester Joint Water Works No. 1, Mamaroneck, N. Y.

FOR SMALL COMMUNITIES . . .

OST Acres, Harris County Water Control and Improvement District 20, Texas. Frank L. Metyko, Consulting Engineer, Houston, Texas. This plant has won a Texas State Dept. of Health award for the quality of its effluent.

Activated Sludge

'PAKAGE' PLANTS



FOR INDUSTRIES, AIRPORTS AND SUPERHIGHWAYS . . .

Activated Sludge 'Pakage' Plant installed for the Goodyear Tire & Rubber Company Plant, Topeka, Kansas. This 18' unit is designed to treat 125,000 gallons per day. J. G. Turnbull, Consulting Engineer.

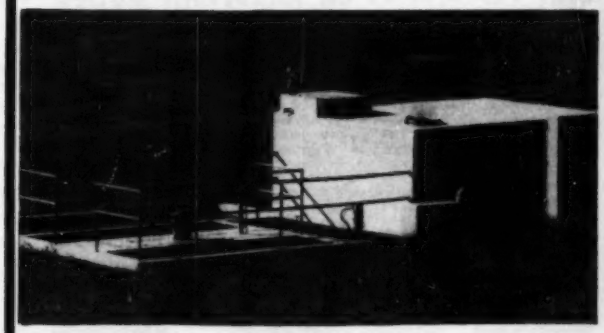
PERFORMING DEPENDABLY IN MORE THAN 230 INSTALLATIONS

Activated Sludge 'Pakage' Plants have a proven 19 year record for producing sparkling clear effluent.

Aeration and clarification are accomplished in a single tank with positive sludge control that covers a wide range of sewage flows and strengths.

'Pakage' Plants handle sewage flows of from 1500 to 500,000 gallons per day in single or multiple units, and may be safely located near dwellings, as the clear effluent produced is free of flies, foul odors and unsightly appearances.

Many semi-automatic features simplify operation and assure trouble-free performance under all conditions. 'Pakage' Plants can be operated by men with State Board of Health minimum classification.



FOR SCHOOLS, HOSPITALS, AND OTHER INSTITUTIONS . . .

Activated Sludge 'Pakage' Plant at Contra Costa, Jr. College, Contra Costa, California. This 7' unit is designed to treat 15,000 gallons per day. Roy E. Ramseier, Consulting Engineer.

Complete Data

including operating performance charts, specifications, etc., is available upon request.

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SEWAGE EQUIPMENT DIVISION

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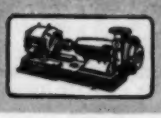
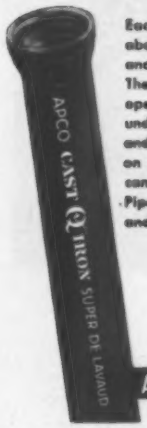
Flush Kleen, Scru-Peller, Plunger, Horizontal and Vertical Non-Clogs Water Seal Pumping Units, Samplers.



Swing Diffusers, Stationary Diffusers, Mechanical Aerators, Combination Aerator-Clarifiers, Comminutors.



Each length of pipe we manufacture passes through the above hydrostatic test press where it is filled with water and the pressure raised to 500 pounds per square inch. The most common water works pipe is designed for an operating pressure of 150 pounds per square inch. This undergoes the 500 pounds per square inch hydrostatic test and permanent records for each piece of pipe are kept on file for inspection by our customers at all times. You can be assured with Alabama's Super De Lavaud Cast Iron Pipe. In sizes of 3" to 24" in modern long lengths. Bell and Spigot, Mechanical Joint and Flanged Pipe.

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68 Loucks Street, Aurora, Illinois

Meetings Scheduled

1954 JAN.	S	M	T	W	T	F	S
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Sept. 8-10—Newark, Del. *(Univ. of Delaware)*
ANNUAL SHORT COURSE FOR WATER AND SEWAGE PLANT OPERATORS. (Sponsored by Md.-Del. Water & Sewage Association and Chesapeake Section A.W.W.A. in cooperation with Univ. of Delaware.) Sec'y, W. McLean Bingley, 504 Wingate Road, Baltimore 10, Md.

Sept. 8-11—Digby, Nova Scotia *(Digby Pines Hotel)*
MARITIME PROFESSIONAL MEETING, ENGINEERING INSTITUTE OF CANADA, ASSOCIATION OF PROFESSIONAL ENGINEERS. Write, G. W. Frey, P.O. Box 1507, Halifax, N. S.

Sept. 9-10—Montauk, N. Y. *(Montauk Manor)*
NEW YORK SECTION A.W.W.A. (Annual Fall Meeting.) Sec'y, Kimball Blanchard, 50 West 50th Street, New York, N. Y.

Sept. 14-16—Waterloo, Iowa *(Hotel Russell-Lampson)*
IOWA SEWAGE WORKS ASSOCIATION. Sec'y, L. F. Skorczeski, 207 South 15th Ave., Marshalltown, Ia.

Sept. 15-17—Muskegon, Mich. *(Occidental Hotel)*
MICHIGAN SECTION A.W.W.A. Sec'y, T. L. Vander Velde, Dept. of Health, Lansing 4, Mich.

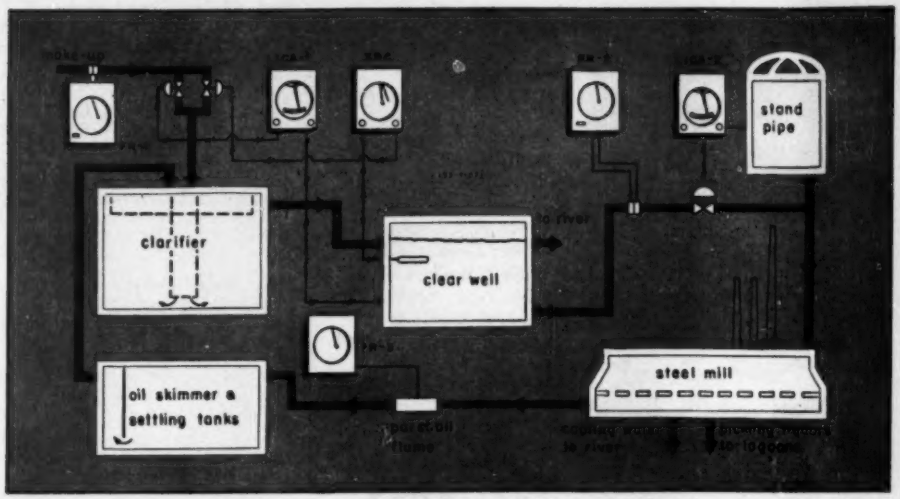
Sept. 19-22—Atlantic City, N. J. *(Hotel Claridge—Exhibits, Convention Hall)*
AMERICAN PUBLIC WORKS ASSOCIATION. Exec. Dir., Donald Herrick, 1313 E. 60th St., Chicago 37, Ill.

Sept. 20-22—Nashville, Tenn. *(Andrew Jackson Hotel)*
KENTUCKY-TENNESSEE SECTION A.W.W.A. Sec'y, J. Wiley Finney, Jr., 420 6th Ave., N., Nashville, Tenn.

Sept. 20-22—Nashville, Tenn. *(Andrew Jackson Hotel)*
KENTUCKY-TENNESSEE INDUSTRIAL WASTES & SEWAGE WORKS ASSOCIATION. Sec'y, R. Paul Farrell, 420 6th Ave., N., Nashville 3, Tenn.

Sept. 22-24—Dayton, Ohio *(Biltmore Hotel)*
OHIO SECTION A.W.W.A. Sec'y, M. E. Druley, Dayton Power & Light Co., Wilmington, Ohio.

Sept. 22-24—Regina, Sask. *(Saskatchewan Hotel)*
WESTERN CANADA WATER & SEWAGE CONFERENCE. Sec'y, W. J. Waddell, 3610 Manchester Road, Calgary, Alberta.



Raw water from a nearby river is fed to a clarifier, through a clear well and then to the mill where part of it is used for cooling and processing. To reduce the amount of make-up, a sizeable portion of the processing water is returned to the treating plant.

Engineered instrumentation aids economical usage of water

TWENTY MILLION gallons of water per day are used in producing steel, at Alan Wood Steel Co., Conshohocken, Pa. Treating this tremendous volume of water for plant use is a big job . . . to which Brown instruments lend valuable assistance.

At each stage, Brown instruments keep operations in coordinated, efficient step with each other. A temperature controller on the clear well, for example, holds water temperature down to an effective value for cooling, by allowing more river water to enter the system when needed to counteract the heat of the water returned from the mill. A liquid level controller also regulates flow of make-up to maintain a preset minimum level in the clear well. Other Brown instruments work together to give a continuous, clear picture of flows, liquid levels, and pump discharge pressures throughout the treatment process.

A complete line of Brown instruments, and specialized, technical experience are ready to serve your water and waste treatment problems. Your nearby Honeywell sales engineer will be glad to discuss your applications with you and your consulting engineer. Call him today . . . he's as near as your phone.

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● **REFERENCE DATA: Write for Bulletin 1160, "Measuring and Controlling Liquid Level"... and Catalog 2320, "Flow Meters"**

MINNEAPOLIS **Honeywell**
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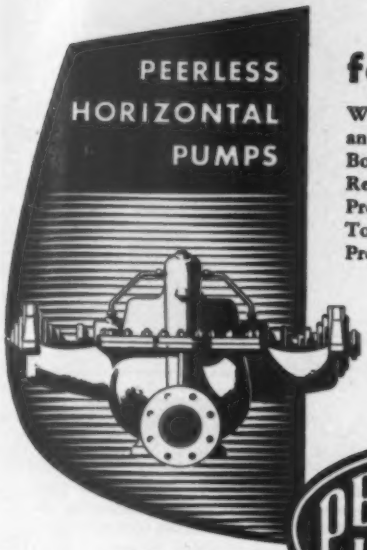
First in Controls



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Sept. 22-24—Grand Forks, N. D. *(Dakota Hotel)*
NORTH DAKOTA WATER & SEWAGE WORKS CONFERENCE. Sec'y, Jerome H. Svore, State Dept. of Health, Bismarck, N. D.

Sept. 22-24—Atlanta, Ga. *(Ga. Institute of Technology)*
GEORGIA WATER & SEWAGE SHORT SCHOOL. Write, A. T. Storey, 1210 Hemphill Ave., N.W., Atlanta, Ga.

Sept. 26-28—Jefferson City, Mo. *(Governor Hotel)*
MISSOURI SECTION A.W.W.A. Sec'y, Warren A. Kramer, State Office Bldg., Jefferson City, Mo.

Sept. 26-28—Jefferson City, Mo. *(Hotel Governor)*
MISSOURI WATER & SEWAGE CONFERENCE. Sec'y, Warren Kramer, State Office Building, Jefferson City, Mo.

Sept. 28-30—Green Bay, Wis. *(Northland Hotel)*
WISCONSIN SECTION A.W.W.A. Sec'y, Leon A. Smith, City Hall, Madison 3, Wis.

Sept. 28-30—Mitchell, S. D. *(Lawler Hotel)*
SOUTH DAKOTA WATER & SEWAGE WORKS. Sec'y, Charles E. Carl, State Dept. of Health, Pierre, S. D.

Oct. 4-5—Moncton, New Brunswick, Can. *(Hotel Brunswick)*
MARITIME BRANCH, AMERICAN WATER WORKS ASSOCIATION. Sec'y, J. D. Kline, P.O. Box 574, Halifax, N. S.

Oct. 4-6—Poland Spring, Me. *(Poland Spring House)*
NEW ENGLAND WATER WORKS ASSOCIATION. (73rd Annual Convention). Sec'y, Jos. C. Knox, 204 Tremont Bldg., Boston, Mass.

Oct. 4-6—Atlantic City, N. J. *(Chalfonte-Haddon Hall)*
PENNSYLVANIA MUNICIPAL AUTHORITIES ASSOCIATION. Sec'y, Claude C. Fogelman, 1717 Main St., Northampton, Pa.

Oct. 6-8—St. Paul, Minn. *(Lowry Hotel)*
MINNESOTA SECTION A.W.W.A. Sec'y, Leonard N. Thompson, Gen. Mgr., Water Department, St. Paul, Minn.

Oct. 11-14—Cincinnati, O. *(Netherland Plaza Hotel)*
FEDERATION OF SEWAGE & INDUSTRIAL WASTES ASSOCIATIONS. (27th Annual Convention). Exec. Sec'y, W. H. Wisely, 325 Illinois Bldg., Champaign, Ill.
(In conjunction with)
OHIO SEWAGE & INDUSTRIAL WASTES TREATMENT ASSOCIATION. Sec'y, Ward E. Conrad, 301 Ohio Departments Bldg., Columbus 15, Ohio.

Oct. 11-15—Buffalo, N. Y. *(Statler Hotel—Tech. Sessions, Memorial Auditorium)*
AMERICAN PUBLIC HEALTH ASSOCIATION. (Annual Meeting.) Sec'y, Mrs. W. R. Walsh, A.P.H.A., 1790 Broadway, New York, N. Y.

Oct. 13—Brunswick, Me.
MAINE WATER UTILITIES ASSOCIATION. Sec'y, Earle A. Tarr, 15 Bowdoin St., Winthrop, Me.

Oct. 13-15—Cedar Rapids, Iowa *(Roosevelt Hotel)*
IOWA SECTION A.W.W.A. Sec'y, H. V. Pedersen, Municipal Bldg., Marshalltown, Iowa.

Oct. 17-20—El Paso, Texas *(Cortez Hotel)*
SOUTHWEST SECTION A.W.W.A. Sec'y, Leslie A. Jackson, Robinson Memorial Auditorium, Little Rock, Ark.

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No matter whether your water problems are SIMPLE or COMPLEX – INFILCO has the answers. If softening or clarification, removal of color or iron, or tastes and odors are involved – INFILCO has the experience and equipment to do the job. Listed below are a few of the bulletins containing useful information for you. DON'T DELAY – WRITE TODAY. For more information on a specific problem contact our Tucson office or any of our 33 field offices.

ARE YOU LOOKING FOR GENERAL INFORMATION ON MUNICIPAL PLANT EQUIPMENT?

Write for our condensed catalog containing information to help you in selecting the more detailed bulletins which are available covering all the types of water and sewage treatment.

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DO YOU WANT INFORMATION ABOUT THE MOST MODERN FILTER CONTROLLERS & GAUGES?

C.-A.-P. SYSTEM® instruments provide flow control as well as accurate measurement of loss of head and rates of flow.

Bulletin 1100-E

ARE YOU CONSIDERING A CLARIFICATION OR SOFTENING PLANT?

Whether a new plant or enlargement of an old is needed, the ACCELATOR® clarifier or softener will provide the best results at the lowest installed cost. In many cases an "ACCELATOR" mechanism can be installed in an existing basin to increase capacity as much as 400%.

Bulletin 1825-E

DO YOU NEED WATER TREATMENT FOR SMALL COMMUNITIES?

The "ACCELAPAK" treating plant employs the most modern methods of treatment – developed specifically for small municipalities where technically trained operators are not available.

Bulletin 1870-E

It's the results that count!

INFILCO equipment and treatment methods have long been recognized leaders in the field because emphasis is on performance with the best combination of equipment for effective, economical operation.

INFILCO INFILCO INC. *Tucson, Arizona*

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SALES OFFICES IN 33 PRINCIPAL CITIES IN THE U. S., CANADA AND MEXICO

Oct. 18-20—Pittsburgh, Pa. *(Hotel William Penn)*
ENGINEERS SOCIETY OF WESTERN PENNSYLVANIA. (15th Annual Water Conference). Sec'y, W. M. Porter, Hotel Wm. Penn, Pittsburgh, Pa.

Oct. 18-22—New York, N. Y. *(Statler Hotel)*
AMERICAN SOCIETY CIVIL ENGINEERS. (Annual Meeting). Exec. Sec'y, Wm. N. Carey, 33 West 39th St., New York, N. Y.

Oct. 19-22—Atlantic City, N. J. *(Chalfonte Hotel)*
PENNSYLVANIA WATER WORKS ASSOCIATION. Sec'y, David Dunlap, 504 N. Second St., Harrisburg, Pa.

Oct. 21-23—Eugene, Ore. *(Upper Willamette Valley)*
PACIFIC NORTHWEST SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sec'y, Walter W. Saxton, 408 Old Capitol Bldg., Olympia, Wash.

Oct. 24-27—Birmingham, Ala. *(Tutwiler Hotel)*
ALABAMA-MISSISSIPPI SECTION A.W.W.A. Sec'y, Charles W. White, State Department of Health, Montgomery, Ala.

Oct. 25-27—Montreal, Quebec *(Windsor Hotel)*
CANADIAN INSTITUTE ON SEWAGE & SANITATION. Sec'y, Dr. Alfred E. Berry, Ontario Dept. of Health, Parliament Bldgs., Toronto, Ont.

Oct. 25-27—St. Louis, Mo. *(Statler Hotel)*
AMERICAN CONCRETE PIPE ASSOCIATION. (Fourth Annual Short Course). Director, Howard F. Peckworth, 228 N. LaSalle St., Chicago 1, Ill.

Oct. 26-29—Long Beach, Calif. *(Wilton Hotel)*
CALIFORNIA SECTION A.W.W.A. Sec'y, Henry F. Jerauld, 1040 Manzanita, Pasadena, Calif.

Oct. 27-28—Springfield, Ill.
ILLINOIS WATER WORKS OPERATORS CONFERENCE. Sec'y, Clarence W. Klassen, State Dept. of Health, Springfield, Ill.

Oct. 27-29—Baltimore, Md. *(Belvedere Sheraton Hotel)*
CHESAPEAKE SECTION A.W.W.A. Sec'y, Carl Lauter, 6955 33rd St., Washington 5, D. C.

Oct. 28—Bridgeport, Conn. *(Hotel Stratfield)*
NEW ENGLAND SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sec'y, Stephen M. Hurley, Jr., 331 State Office Bldg., Providence, R. I.

Nov. 3-5—Richmond, Va. *(Jefferson Hotel)*
VIRGINIA SECTION A.W.W.A. Sec'y, J. P. Kavanaugh, 915 Colonial-American Bank Bldg., Roanoke 11, Va.

Nov. 4-6—Atlantic City, N. J. *(Madison Hotel)*
NEW JERSEY SECTION A.W.W.A. Sec'y, C. B. Tygert, Box 178, Newark 1, N. J.

Nov. 8-9—Huntington, W. Va. *(Hotel Prichard)*
WEST VIRGINIA SECTION A.W.W.A. Sec'y, Harry K. Gidley, State Dept. of Health, Charleston 5, W. Va.

Nov. 7-10—St. Petersburg, Fla. *(Soreno Hotel)*
FLORIDA SECTION A.W.W.A. Sec'y, Wm. W. Aultman, Box 316, Coconut Grove Sta., Miami 33, Fla.

Nov. 8-10—Asheville, N. C. *(George Vanderbilt Hotel)*
NORTH CAROLINA SECTION A.W.W.A. Sec'y, E. C. Hubbard, P.O. Box 2091, Raleigh, N. C.

Nov. 9-10—Colorado Springs, Colo. *(Broadmoor Hotel)*
ROCKY MOUNTAIN SECTION A.W.W.A. Sec'y, Geo. J. Turre, Box 600, Denver, Colo.

Nov. 9-10—Huntington, W. Va. *(Prichard Hotel)*
WEST VIRGINIA SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sec'y, G. O. Fortney, State Dept. of Health, Charleston, W. Va.

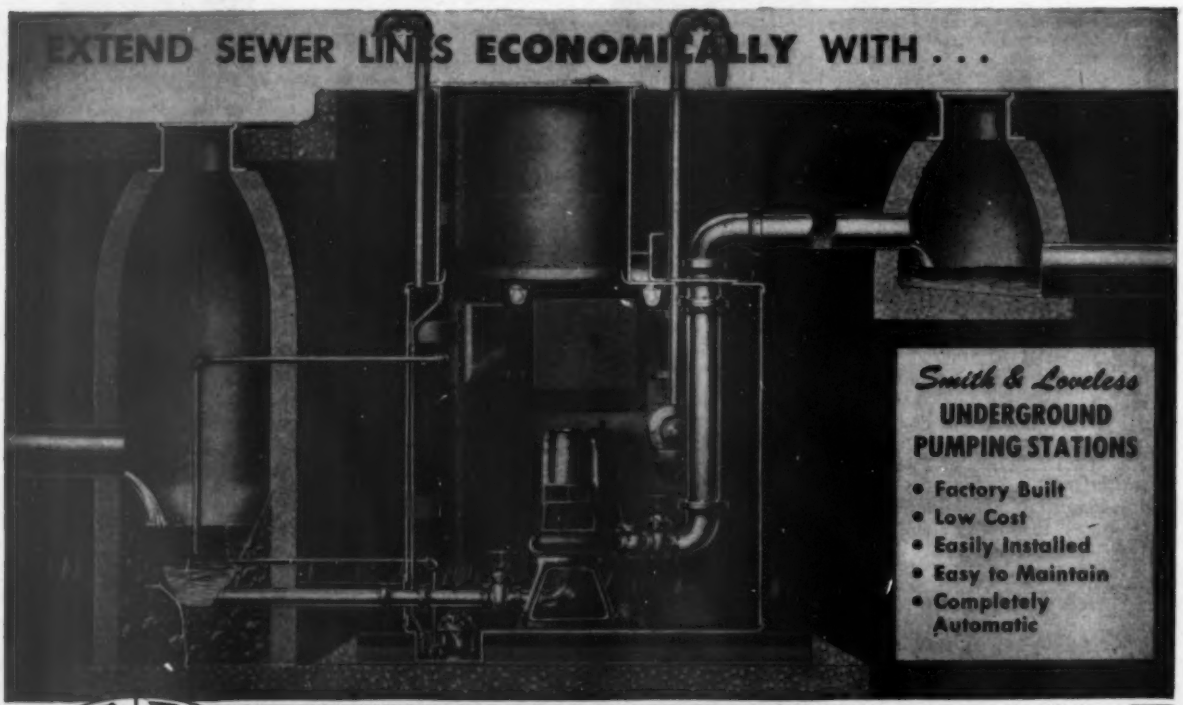
Nov. 11-12—McCook, Neb. *(Keystone Hotel)*
NEBRASKA SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sec'y, Paul W. Mousel, 602 West B Street, McCook, Neb.

Nov. 17-19—Allerton Park, Ill. *(Univ. of Illinois)*
ILLINOIS WATER WORKS MANAGEMENT SHORT COURSE. Director, Dr. T. E. Larson, State Water Survey, Urbana, Ill.

Nov. 28-Dec. 3—New York, N. Y. *(Statler Hotel)*
AMERICAN SOCIETY OF MECHANICAL ENGINEERS. (Annual Meeting). Sec'y, C. E. Davies, 29 West 33rd St., New York, N. Y.

Dec. 2-4—Havana, Cuba *(Sociedad Cuban de Ingenieros)*
CUBAN SECTION A.W.W.A. Sec'y, Laurence H. Daniel, Baratillo 9, Havana, Cuba.

Dec. 8—Winthrop, Me.
MAINE WATER UTILITIES ASSOCIATION. Sec'y, Earle A. Tarr, 15 Bowdoin St., Winthrop, Me.



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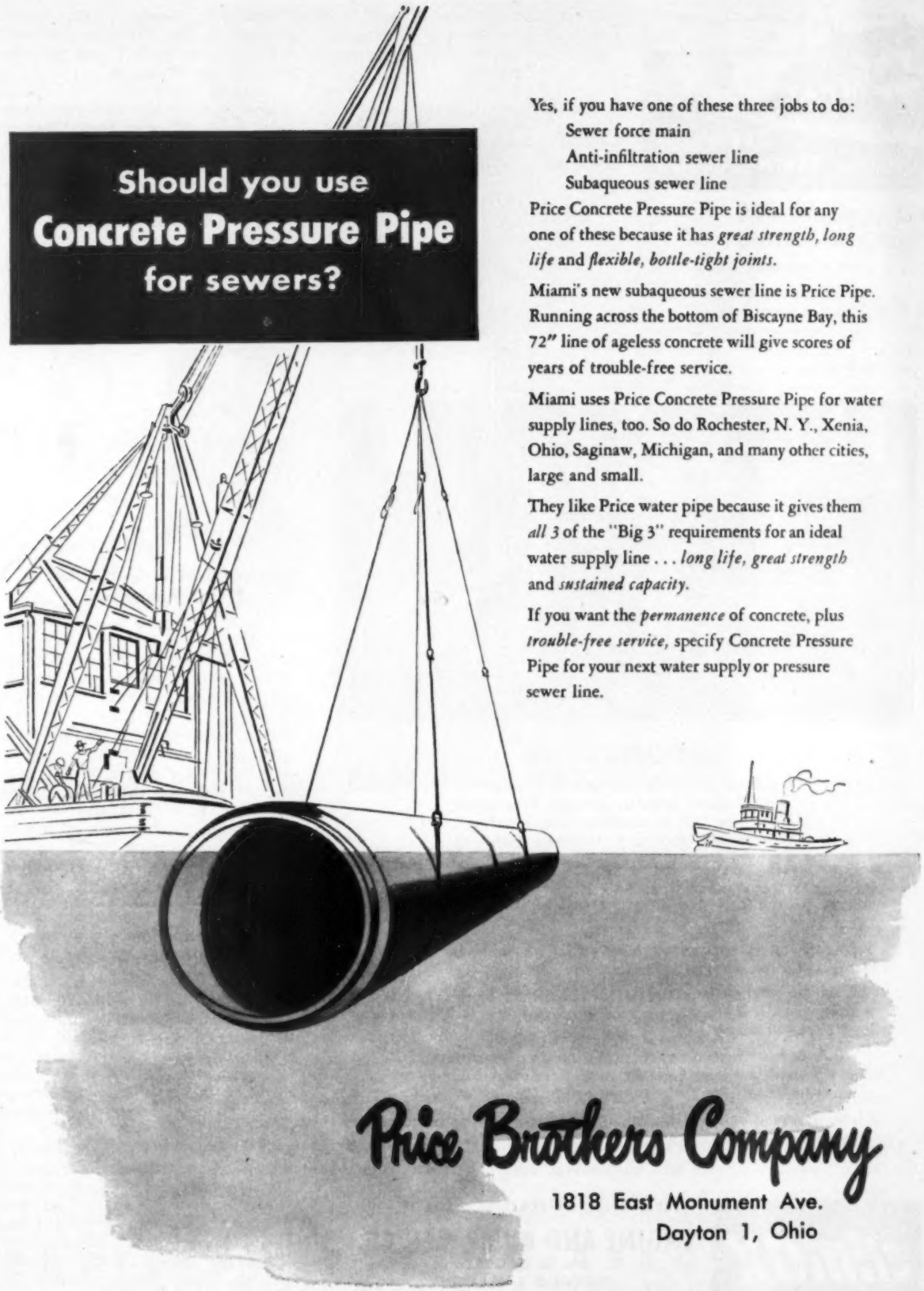

Should you use Concrete Pressure Pipe for sewers?

Yes, if you have one of these three jobs to do:

Sewer force main
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Subaqueous sewer line

Price Concrete Pressure Pipe is ideal for any one of these because it has *great strength, long life* and *flexible, bottle-tight joints.*

Miami's new subaqueous sewer line is Price Pipe. Running across the bottom of Biscayne Bay, this 72" line of ageless concrete will give scores of years of trouble-free service.

Miami uses Price Concrete Pressure Pipe for water supply lines, too. So do Rochester, N. Y., Xenia, Ohio, Saginaw, Michigan, and many other cities, large and small.

They like Price water pipe because it gives them *all 3* of the "Big 3" requirements for an ideal water supply line . . . *long life, great strength* and *sustained capacity.*

If you want the *permanence* of concrete, plus *trouble-free service,* specify Concrete Pressure Pipe for your next water supply or pressure sewer line.

Price Brothers Company

1818 East Monument Ave.
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Concrete Pressure Pipe for Water Supply, Subaqueous, Pressure Sewer and Culvert Installations

Pickups from Purdue's "Sanitary Engineering News"

Don E. Bloodgood, Editor

In a civil defense exercise in London, England, firemen used polythene piping for emergency water supplies. The pipe was in 16 ft. sections that weighed 50 pounds each.

Two million gallons of water was imported by Gibraltar (Mediterranean) during a year when there was a shortage of rainfall.

Thermophilic bacteria have been found to be active only under aerobic conditions whereas methane bacteria were active only under anaerobic conditions.

Methoxychlor, mixed as 32 pounds of 50% wettable powder in 100 gallons of water has been recommended for fly control in sludge drying beds.

There are 18 short courses to be offered at the Robert A. Taft Sanitary Enginering Center during the next 12 months.

Ketchikan, Alaska, North America's rainiest city, 190 inches per year, announced on April 1 that the city reservoir was drying up.

More water is lost each year from Lake Mead (Hoover Dam) than is held in most other reservoirs.

There have been 35 industrial waste treatment facilities completed in the State of Indiana in the past year.

The average cost of ferrichloride for filtering sludge at Cincinnati, Ohio, has been $2.89 per ton of dry solids.

14 YEARS LATER

8 Climax Engines installed in 1940 in the Rock Island, Illinois, Sewage Treatment Plant are "all in excellent shape today," reports Mr. Armin J. Grossell, Supt. of Public Service.

2 Engines, rated 75 HP at 720 RPM respectively driving sewage pumps have a total of 12½ years operation between them.

1 Engine, direct connected to a 720 RPM generator has run over 75,000 hours.

5 Engines, rated 125 HP at 1200, connected to storm sewer pumps, operate only during emergencies. One of the 5 has logged 24,000 hours.

A careful maintenance program has contributed to the fine engine performance. Such performance is to be expected when you specify Climax.

Plant designed by and built under supervision of Consoer, Townsend and Associates.

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Factory—Clinton, Ia. *District Office*—Dallas, Tex.

Retirement of C. C. Ruchhoft From PHS Is Announced

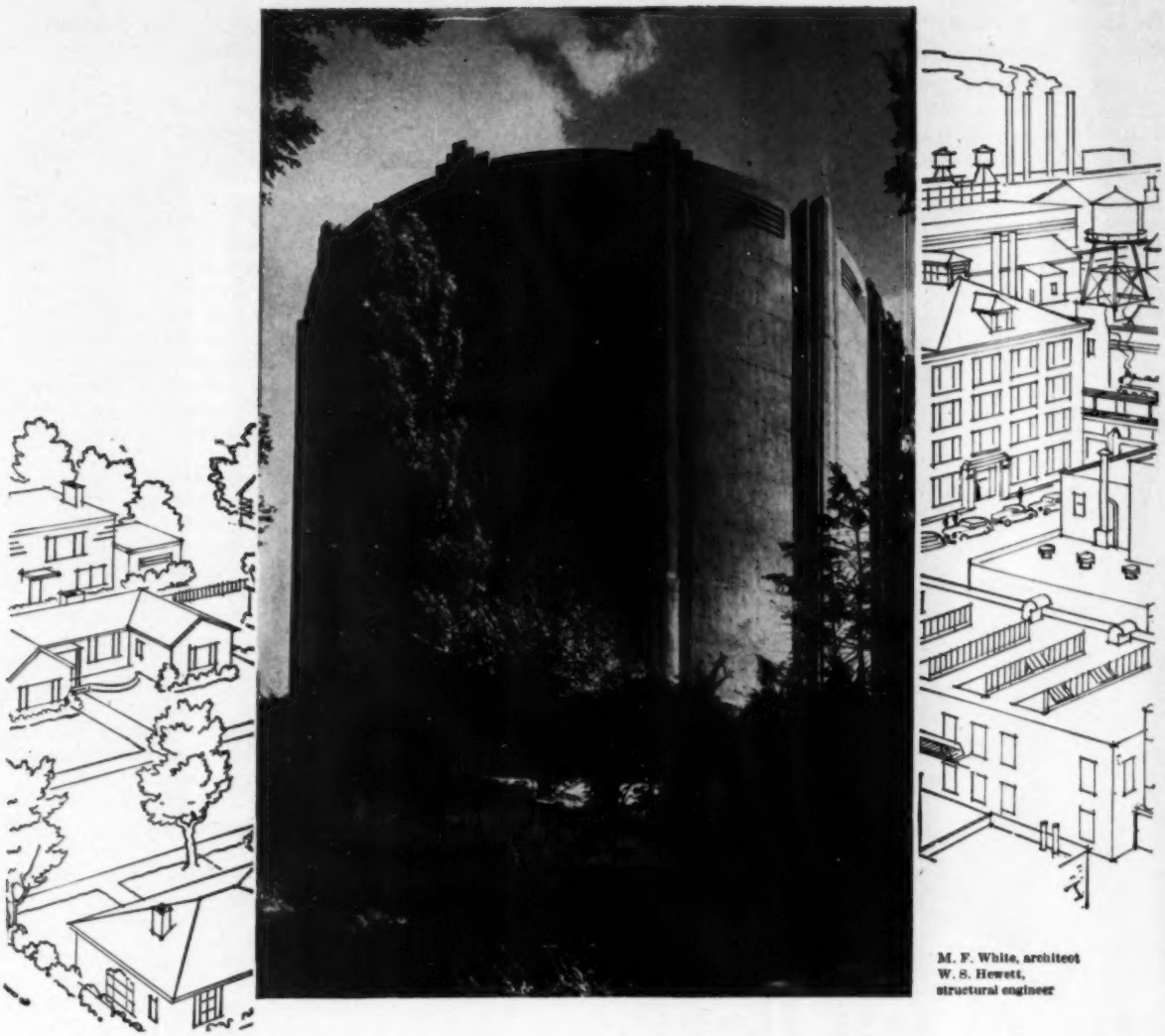
The retirement of C. C. Ruchhoft on July 1st has been announced by V. G. MacKenzie, Officer in Charge of the Sanitary Engineering Center, Public Health Service, Cincinnati, Ohio.

Mr. Ruchhoft, who was Chief of the Physics and Chemistry Section, was retired for disability. His connection with the U.S.P.H.S. began in 1921. He is the author of over 100 articles, and has been selected to receive the Emerson Medal of the F.S.&I.W.A. at the Association's meeting in October.

Lawrence Experiment Station Condensed History Available

Under the title "Proud Heritage," the Massachusetts Dept. of Public Health has published a condensed history of the Lawrence Experiment Station. The 36-page booklet is generously illustrated with pictures of the buildings, the laboratories, and the individuals involved in the story of Lawrence.

We recommend that all who are interested in the background of sanitation write for a copy of this valuable record. A limited number of copies are available from: Clarence I. Sterling, Jr., Chief Sanitary Engineer, Mass. Dept. of Public Health, State House, Boston 23, Mass.



M. F. White, architect
W. S. Hewett,
structural engineer

FOR WATER TANKS OF DISTINCTION
CHOOSE *CONCRETE*

A WELL-DESIGNED concrete water tank such as this 675,750 gal. water tank in Waukesha, Wisconsin, not only is a distinctive landmark but has long-lasting utility as well. It was built in 1934 and has required no maintenance.

Any city, large or small, can obtain lasting benefits by building such a reinforced concrete water tank. Its sturdy construction gives it the durability to withstand the weathering action of any climate. Its enduring beauty makes it a structure of which the entire community always can be proud.

A reinforced concrete water tank can be erected in practically any location without marring the skyline or depreciating the appearance or value of the property in the area.

Best of all, reinforced concrete water tanks are more economical than other types. They require little or no maintenance. They retain their distinctive appearance over their long life. And they render ***low-annual-cost*** service—the true measure of construction value. Such service pleases taxpayers, engineers and municipal officials alike.

PORTLAND CEMENT ASSOCIATION

33 WEST GRAND AVENUE, CHICAGO 10, ILLINOIS

A national organization to improve and extend the uses of portland cement and concrete through scientific research and engineering field work

To Rutgers University Dorr Co. Sanitation Fellowship

A Fellowship for graduate study in the fields of metallurgical, chemical, and sanitary engineering has been established by The Dorr Company, Engineers, of Stamford, Connecticut, to commemorate the golden jubilee of the invention by Dr. John Van Nostrand Dorr of the Dorr classifier that was the base on which the Dorr Company was later developed.

The Fellowships will be administered by an endowed trust known as the Dorrco Educational Trust. Its initial Board of Trustees are Dr. Norman A. Shepard, Chairman, Dr. Joseph W. Barker, Dr. George O. Curme, Jr., Mr. Hamilton M. Chase, and Dr. J. V. N. Dorr.

The initial Fellowship is offered to Rutgers University, of which Dr. Dorr is both a graduate and trustee, and will be for graduate studies to be carried out in its Department of Sanitation. The appointment will be for a twelve-month period and will carry with it a stipend of $1800 per year plus tuition and one month of vacation.

Air Pollution Control Manual Is Now Available

The publication of an authoritative "Air Pollution Abatement Manual" has been completed according to an announcement by the Manufacturing Chemists' Association.

The issuance of Chapter II, "Terminology and Selected Data," compiled by Willard W. Hodge, Senior Fellow, Mellon Institute of Industrial Research, represents the final step in making available the information on up-to-date research and operational practices related to this important subject. Eleven other chapters, plus a preface and outline of the manual, have previously been published as separate prints.

The Manual includes the best information available on the types of air pollution, legislative requirements, technical methods of handling problems, and suggestions for enlisting the cooperation of employees, industrial and public officials, and the public itself. The entire Manual has been produced under the editorship of C. A. Gosline, Engineering Department, E. I. du Pont de Nemours & Co., Inc.

On request, single complimentary copies of the full thirteen-chapter manual will be supplied to federal, state and municipal officials directly charged with air pollution control responsibilities. For others the price, which represents the cost to the Association, is $6 each, with binder included. Prices of the individual chapters range from 15c to 75c. Chapter II, just issued, is priced at 75c per copy. Address correspondence to: Manufacturing Chemists' Assn., Inc., 1625 Eye Street, N.W., Washington 6, D.C.

NEW...DIFFERENT...

PLASTIC BASE JC-60 CUTS SEWER SYSTEM COSTS

THESE ARE THE FACTS: JC-60® cuts sewer line *maintenance* costs. Joints poured with ATLAS JC-60 resist the common causes of sewer joint failure — root penetration, climate extremes, normal settling, loss of adhesion and chemical attack.

Operating costs go down. By reducing infiltration of soil water, JC-60 sewer joints reduce pumping costs and equipment capacity required at the disposal plant.

Installation costs go down. JC-60, with minimum shrinkage, high fluidity and resistance to overheating deterioration speeds the entire jointing procedure and minimizes material waste.

Years of ATLAS research created this remarkable new jointing compound. Based on a synthetic plastic, JC-60 is designed specifically to provide those characteristics proved most desirable in actual use.

COMPLETE FACTS are in Bulletin M20-3 and other technical literature. *Write for your copies.*

OTHER ATLAS JOINTING MATERIALS *include* **GK®** *and* **SLIPJOINT GK®** *for sewer pipe:* **MINERALEAD®** *and* **HYDRORINGS®** *for cast iron water pipe.*

ATLAS JOINTING COMPOUNDS
... a permanent bond

ATLAS MINERAL PRODUCTS COMPANY MERTZTOWN PENNSYLVANIA

Engineering Representatives Throughout the United States

"Haven't I told you to lay off the Colonel and his hazel branch. We have more scientific ways of finding water—and, I don't mean the Colonel's kind!"

FAMOUS LIGHTHOUSES OF AMERICA

Boston Light, America's first lighthouse, was built in 1716 at the north side of the entrance to the main ship channel in Boston Harbor. The scene of several bitter contests for possession during the Revolutionary War, it was destroyed by the British in 1776. A new tower for this famous light was built in 1783 and is still in use today.

Guiding Light to users of electrochemicals is the integrity of Niagara Alkali Company, for over fifty years a pioneer in the development and production of these important materials. You can rely on Niagara for quality in...

Nialk® Liquid Chlorine, Nialk Caustic Potash, Nialk Carbonate of Potash, Nialk Paradichlorobenzene, Nialk Caustic Soda, Nialk TRICHLORethylene, Niagathal® (Tetrachloro Phthalic Anhydride)

NIAGARA ALKALI COMPANY

60 East 42nd Street, New York 17, N. Y.

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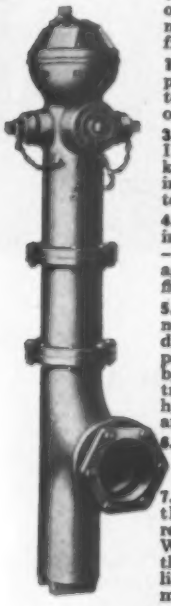
In hydrants, too, it's important to have

Unobstructed flow

Look at a cutaway view before you buy any hydrant! You'll be surprised how few provide an absolutely unobstructed waterway! And *no one* but Iowa offers you *all* this and much more—



1. Provides full and unobstructed waterway for maximum flow of water from main to nozzle.
2. All internal working parts removable through top of hydrant for periodic inspection.
3. Superintendents find Iowa hydrants easy to keep in "tip-top" operating condition—no special tools required.
4. Main valve holds tight in closed position so that—should hydrant be damaged—no loss of water, or flooding, will occur.
5. Two-piece operating nut eliminates binding or distortion of working parts (sometimes caused by expansion and contraction)—makes Iowa hydrants easy to open and close at all times.
6. Complete drainage by sure acting drain, prevents freezing.
7. Fully bronze mounted throughout—meet all requirements of A. W. W. A.—have proved their ruggedness and reliability to waterworks men everywhere.
8. Available with any type of connection.

Get ALL the facts! Write

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A subsidiary of James B. Clow & Sons

Manufacturers & Equipment News

Methyl Purple Titration Indicator

901

Fleisher Chemical Company, Washington, D. C., has available an improved titration indicator—Methyl-Purple.

Methyl-Purple is said to give sharper and more contrasting color changes; requires less time; does not involve so much indecision and whose results are not so dependent upon the moods and color-consciousness of the individual.

In alkaline solution, Methyl-Purple exhibits an emerald green color; in acid solution, a purple color. An intermediate steel gray tint provides a convenient warning of the approaching endpoint in either acidimetric or alkalimetric titrations. Color changes are sharp and distinct, and take place over a very narrow pH range (pH 4.8 to 5.4). Methyl-Purple is stocked and distributed by most laboratory supply houses.

Control of Foul Odors, Flies And Rats In Garbage Disposal

902

Stewart-Hall Chemical Corp., Mt. Vernon, New York, has developed a new economical liquid compound under the trade name of Sanifil, for the control of disagreeable odors on garbage dumps and land fills.

The manufacturer states that one half gallon of the concentrated liquid, added to fifty gallons of water, produces a solution, which if sprayed or sprinkled over garbage, effectively controls or eliminates unpleasant odors.

Furthermore, it is stated that a Sanifil solution, because of its low vapor blanket effect, has a powerful repellent action on flies and most other insects. It prevents the deposition of, or destroys insect larvae. It also serves to prevent rats from making a haven and breeding place within garbage dumps. Although the vapor of this solution is pleasant to humans, insects, rats, and both wild and domesticated animals find it unpleasant and avoid it.

Just Published!

No other book contains all this information on

WATER SUPPLY and WASTE-WATER DISPOSAL

By GORDON MASKEW FAIR, *Harvard University;*
and JOHN CHARLES GEYER, *The John Hopkins University*

With a special chapter on Water Chemistry by John Carrell Morris, Harvard Univ.

Set forth for the first time in this broad work are many of the important advances toward reducing water sanitation to an orderly process of calculation. In order to emphasize fundamentals, the authors have classified the subject matter according to the basic science or unit operation rather than according to the function performed by the complete systems. The resulting integrated discussion of the applications of scientific principles and engineering techniques is an entirely new approach to the material in this field, an approach which gives free rein to the exchange of ideas between the two subjects. The first half of the book deals with collection and distribution; the second half details the treatment of water.

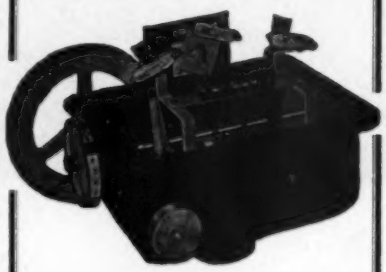
1954—973 pages, illustrated, $15.00

Send for your on-approval copy today.

JOHN WILEY & SONS, Inc.

440 Fourth Avenue New York 16, N. Y.

ROTO-TROL



RF-2

WITH ALTO-TROL

This 2-pump RF-2 Roto-Trol assures equal use and wear of both pumps. Each pump is operated on alternate starting cycles. The RF-2 operates both pumps together, when required. RF-2 installations give dependable service year after year, with the minimum of attention.

Write for full data

WATER LEVEL CONTROLS DIVISION

HEALY-RUFF COMPANY

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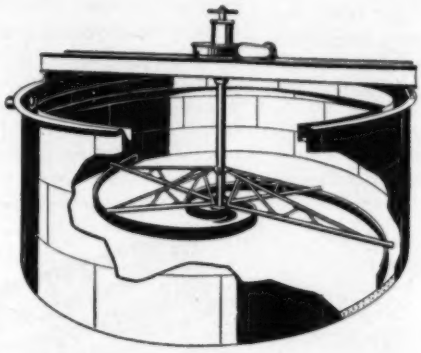
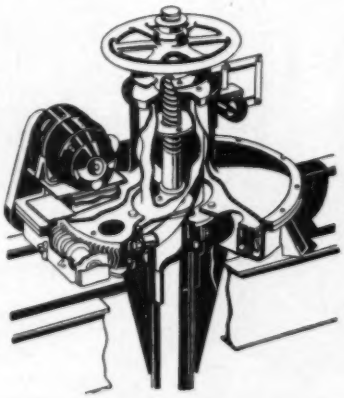


HARDINGE

"AUTO-RAISE"

THICKENERS



One of the distinctive features of Hardinge Thickeners for trade waste and sewage treating is the "Auto-Raise" driving mechanism, which automatically lifts the scraper away from any overload or obstruction in the tank bottom—eliminating costly breakdowns and delays. Another feature of this unit is the double-spiral scraper which removes settled solids in one revolution. Bulletin 31-D-15.

HARDINGE
COMPANY, INCORPORATED

YORK, PENNSYLVANIA • 240 Arch St. • Main Office and Works

New York • Toronto • Chicago • Hibbing • Houston • Salt Lake City • San Francisco

• If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.

Auto Central Filter Control

903

Builders - Providence, Inc., Providence, R. I., has announced "Auto Central Filter Control," a system of a semi-automatic sequence operation for backwashing rapid sand water filters. It was developed to save cost and time, relieve plant personnel for other duties, eliminate supervisory headaches, insure accurate backwashing rates and duration to maintain maximum filter efficiency.

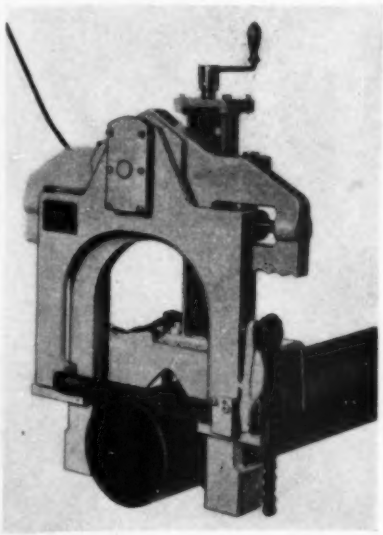
This control system signals the need for filter backwashing in accordance with loss-of-head conditions. The backwash cycle is then initiated and carried out, and the filters returned to operation automatically, without further attention from the operator. Operation can be changed to manual, if desired.

Auto Central Control consists of control panels, containing loss-of-head gauge, filter rate setter, valve position indicators, sequence controller, backwash gauge, backwash starter button and accessories. Control panels are placed in a central location (operators office, for example) and eliminate the need for housing filter tables.

Portable Power Drive

904

The Ridge Tool Company, Elyria, Ohio, has announced that the RIDGID Portable Power Drive for threading, cutting and reaming pipe with hand tools is now made with a new wrenchless Speed-Grip Chuck. It is said to operate on a different principle from conventional hammer chucks, is guaranteed to hold any kind of pipe or rod securely both forward and reverse. To operate, grip-tooth jaws are closed on work by hand wheel, socked lightly, then motor action holds work still tighter. Easy release by hand wheel. This new "400A" power drive handles ⅛" to 2" pipe, ¼" to 2" bolts, has ample power for geared tools to 12".



Portable Power Pipe Saw

905

E. H. Wachs Co., Chicago, Ill., has developed a Portable Power Pipe Saw for on-the-job cutting of 2" to 8" cast iron and steel pipe as well as bar stock and beams. Weighing only 120 pounds and operating in a space 25 inches wide The New Wachs Guillotine Saw easily makes tough cuts in tight places. In the field cuts formerly made by hand can now be machine made in a matter of minutes.

Chain pipe vise clamps Guillotine Saw to pipe, ready to cut, in a matter of seconds. Machined cast steel V saddle base assures a square cut at right angle to pipe. Pipe acts as machine tool base.

Pipe is cut in a matter of minutes—6" standard wall steel pipe cut in 8 minutes—6" standard wall cast iron pipe cut in 4 minutes. Cutting time depends on pipe characteristics.

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Complete Ford catalog No. 50 of time and money saving meter equipment.

FORD SPECIAL
METER TESTING BENCHES
offer High Efficiency

In many large meter shops the volume of testing justifies special equipment. The possibilities are worth investigating. Write for information.

THE FORD METER BOX COMPANY, INC.
Wabash, Indiana
FOR BETTER WATER SERVICES
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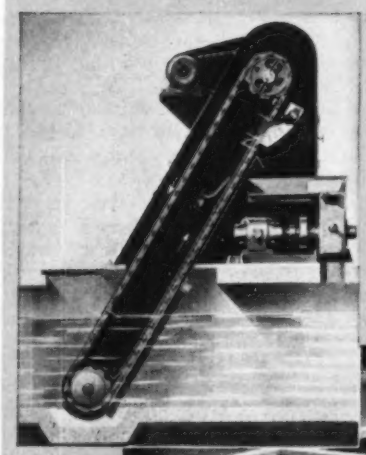
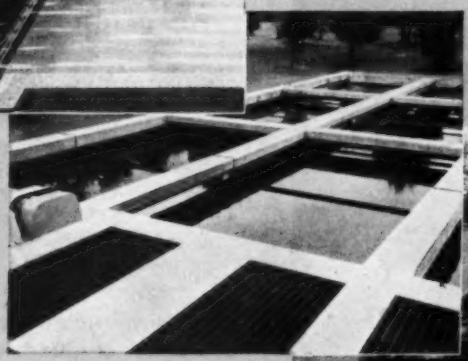
we treat them all like *finger prints!*

Just as no two sets of finger prints are ever alike, so, too, are all sewage and waste treatment problems *different.* Velocities, head loss, capacities, site conditions, tank or chamber hydraulic conditions, and many other factors vary from plant to plant. That is why we at Chain Belt have no standard answer to a treatment problem. We study each application carefully, and from our broad background of experience recommend the type and size of equipment you need for most efficient, economical results. From the broad range of Chain Belt Sewage and Waste Treatment Equipment, we select the exact units that can be best adapted to your particular conditions.

So, don't just specify equipment. Ask your nearest Rex Sales Engineer to work with you to assure the results you want, or write direct to Chain Belt Company, 4610 W. Greenfield Ave., Milwaukee 1, Wis.

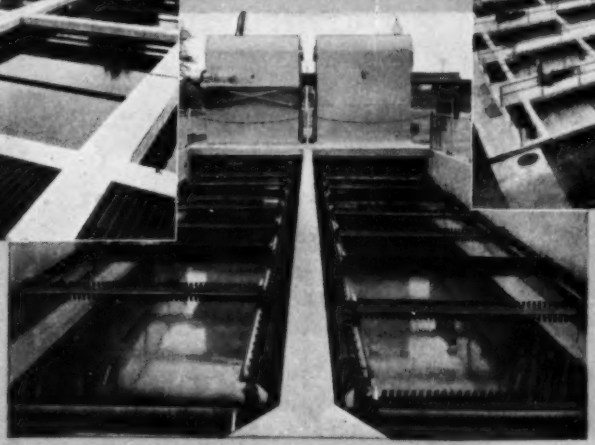


Rex Mechanical Cleaned Bar Screens and Triturators



Rex Vorti-Flo® Clarifiers

Rex Conveyor Sludge Collectors



Rex Grit Collectors

CHAIN BELT COMPANY

District Sales Offices in all principal cities

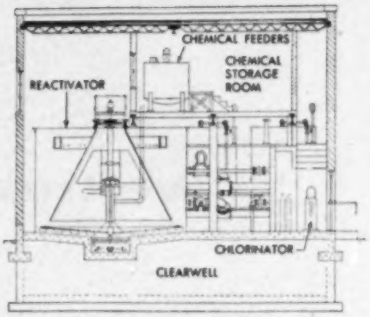
• If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.

TEFC and Explosion-Proof 150 H.P. Motors

906

U. S. Electrical Motors Inc., Los Angeles, Calif., has announced that maximum ratings available of U. S. horizontal totally-enclosed and explosion-proof motors have just been increased to 150 H.P. The totally-enclosed motors, known as Type SD, are designed for protection against dirt, moisture, oil and chemicals. The explosion-proof motors, Type SE, are designed for service where inflammable gases, volatile liquids or combustible dusts may be present. Type SE motors are supplied with the Underwriters' Laboratories label for Class I—Group D, and Class II—Groups F and G.

Both type motors are double-enclosed with a built-in fan for full ventilation and greater heat dissipation. Additional features include asbestos-protected windings to withstand high temperatures; stator cover plate which can be easily removed for inspection or cleaning; solid, dynamically balanced, cast aluminum motor; Lubriflush bearings for re-lubrication without disassembly; and normalized castings for permanent machining accuracy.



High-Rate Package Water Treatment Plant

907

Graver Water Conditioning Co., New York, N. Y. has developed a compact and completely integrated package-type water treatment plant for economy-minded smaller communities. It integrates all equipment from inlet to outlet, including the clearwell, chlorinator, wet or dry chemical feeders and proportioners, gravity or pressure filters, recarbonator when required, level and flow controls and instruments, and interconnecting piping. Standard layouts for the complete package plant are available in a wide selection of capacities from 0.1 to 2.0 MGD, special layouts being available for larger capacities.

The heart of this low-cost plant is the well-known, widely used Graver Reactivator, a cold-process water treating unit used for selective or simultaneous removal of turbidity, color, and organic matter; taste and odor; iron and manganese; and hardness, from water supplies. It is a self-contained, high rate unit of the solids-contact type, embodying within a single compartmented tank all the established functions of coagulation, flocculation, sedimentation, and sludge removal that, in conventional plants, are performed in separate tanks. The integration of these functions within a single tank is an important space-saving feature.

Water-Dispersible Chlorobenzene For Control of Obnoxious Odors

908

Solvay Process Division, Allied Chemical & Dye Corporation, New York, N. Y., has announced a new product, "Orthosolv," which is described as a water-dispersible chlorobenzene odor suppressant for controlling obnoxious odors that may result from garbage and refuse disposal and sewage treatment. The company reports that this is the first time that a product of this type has been available at a practical price.

Pekrul Grows

To keep pace with the ever increasing demand for PEKRUL GATES over half a century, MORSE BROS. MACHINERY has just completed an extensive modernization program. The installation of many new machines and facilities, an increased engineering staff, and complete, new, custom re-tooling specifically for PEKRUL GATE production means...

modern design and superior engineering service...

even faster PEKRUL GATE deliveries to you...

PEKRUL GATE DIVISION

MORSE BROS. MACHINERY
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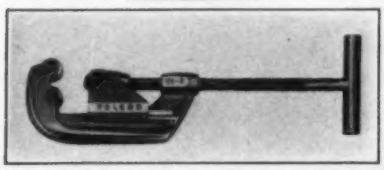
MANUFACTURERS OF PEKRUL GATES FOR

Flood Control · Sewage Disposal · Rearing Ponds · Recreation Pools
Levees · Reservoirs · Irrigation · Cooling Towers · Pumping Plants
Water Works · Oil Refineries · Steel Mills · Dams · Fish Hatcheries

The manufacturer states that the chlorobenzenes in Orthosolv act in three ways to control undesirable odors: they effectively mask existing obnoxious odors; they control the growth of the micro-organisms that produce sulphides with their characteristic strong, unpleasant odors; and they prevent the growth of fungi that speed the decomposition of waste materials which causes offensive odors. The product is said to be effective even when used in solutions as dilute as one part in 100 parts of water, and can be sprayed on the affected areas with any normal pumping equipment.

In addition to controlling odors which can occur in land fill refuse disposal projects and in sewage treatment, Orthosolv is reported to find odor control applications in drainage ditches, storm sewers, market area streets, and refuse cans and trucks.



Heavy Duty Pipe Cutter

909

Toledo Pipe Threading Machine Co., Toledo, Ohio, has announced a new Toledo heavy duty Pipe Cutter. Designed to produce clean smooth cut-offs with positive easy action, this new cutter is of the wheel and roller type. Capacity ⅛″ to 2″ pipe.

Features that save time and improve performance in cutting operations include—simple modern design, hooks on pipe easily . . . tracks perfectly . . . sturdy malleable frame formed to fit the hand and guaranteed warp-proof. High alloy steel cutter wheels leave practically no burr. Rollers in hook provide a square base when starting tool on pipe. Single cutter wheel is in the sliding block.

Protective Coating

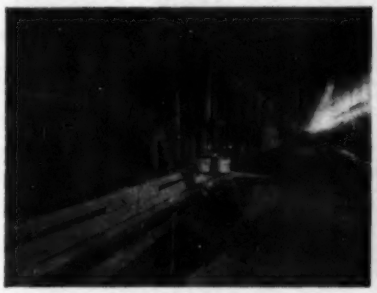
910

The Atlas Mineral Products Company, Mertztown, Pa., has announced the availability of an elastic maintenance coating for light duty corrosion service. This product, which eliminates compounding on the job, is available as gray or black colors in standard containers. The material, which is sold under the registered trade name of ELPRENE, is based on a joint development by Du Pont and the Atlas Mineral Products Company. Elprene is comparable in price to other standard Atlas liquid Neo-

Continued on page 110A

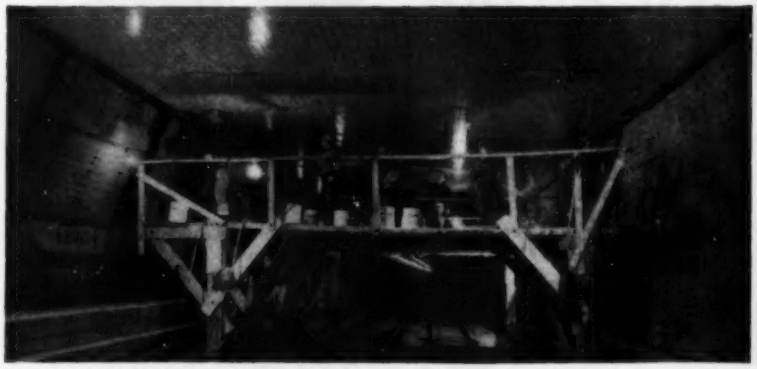
Underneath the river!

THORITE Patching Mortar Crew at work in Air Tunnel under East River, New York.



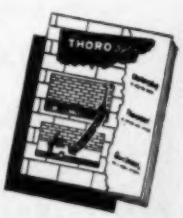
Sealing Leaks in Traffic Tunnel with WATERPLUG.

Sealing Drain Pipe Channels in Tunnel with WATERPLUG.



WATERPLUG Crew at work, before placing of tile lining, Battery Tunnels, East River, New York.

On many of the largest underground projects in the Americas and in foreign countries, WATERPLUG solves, for the contractor, his water problems. The job may be small or it may be large, the results are the same — Successful.



Get our 20-page brochure, pictorially describing, in detail, "How To Do It." It's yours for the asking. — No. 140.

Standard Dry Wall Products

BOX X, NEW EAGLE, PENNSYLVANIA

prene products, such as Neobon liquid Neoprene coating, and Neelium standard high solids liquid Neoprene coating.

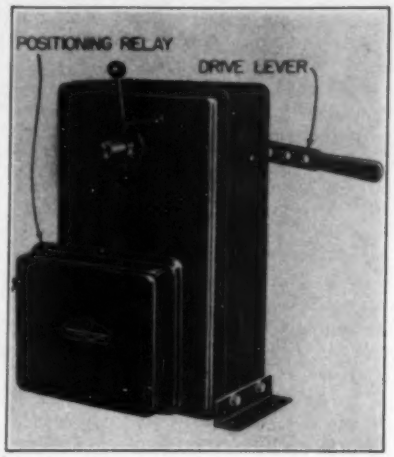
New, Small Control Drive Improves Flow Control

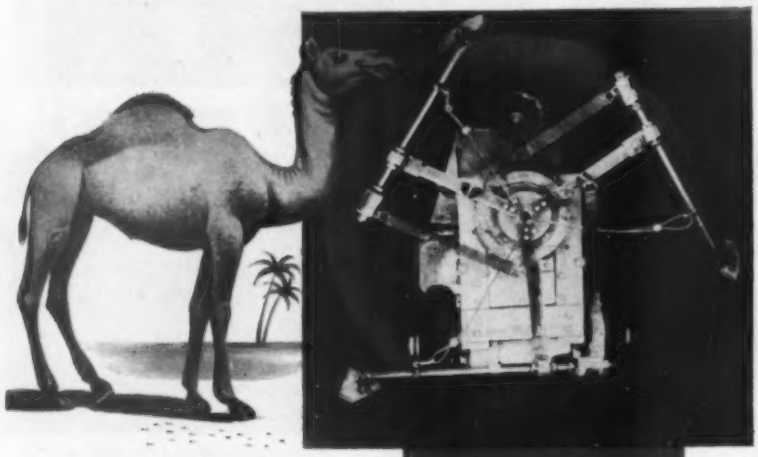
911

Bailey Meter Co., Cleveland, Ohio, has announced that gas and liquid flow regulation may be improved by use of a new, small, pneumatically-operated control drive. Butterfly valves, dampers, feeders, etc., may now be operated on a straight-line-flow characteristic.

A pneumatic signal actuates a positioning relay which in turn accurately positions a piston-operated drive lever arm. Three different characteristic cams are supplied and may be shaped if necessary.

The drive is compact (10″ x 11″ x 19″) and may be installed in any position on a column, pipe or flat surface. Time required for full travel (75°) is adjustable. The drive has a 4 in. piston stroke at a torque of 75 ft-lb. It operates on standard SAMA signal ranges 3-15 and 3-27 psig. Standard connecting linkage is available from stock.





CENTRILINE goes to Aden

Deep in the middle east, Centriline is currently centrifugally lining 11,920 feet of salt water mains for the Anglo Iranian Petroleum Company's Aden Refinery. The mains vary in diameter from 24″ to 74″ and are being lined with cement mortar in thicknesses of from ⅜″ to ¼″. The General Contractor, George Wimpy & Co. of England and the Pipe & Erection Contractor, Bechtel International Corp. of San Francisco, selected the Centriline process for the same reasons that have made it famous across the United States . . . guarantee against interior leakage, corrosion and tuberculation . . . low pumping costs . . . and high carrying capacity. Whether old or new, when a pipe is Centrilined its life is extended indefinitely. For complete details, call on Centriline today.

3,000,000 FEET OF EXPERIENCE

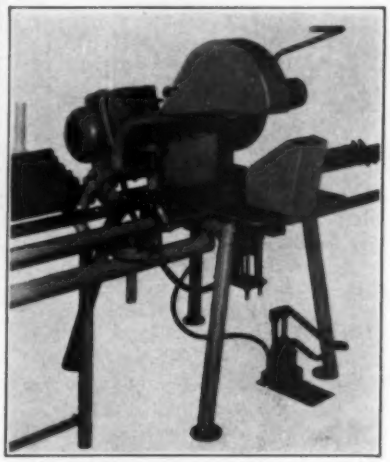
CEMENT-MORTAR LINING OF PIPES IN PLACE

CENTRILINE CORPORATION

A subsidiary of Raymond Concrete Pile Co.

140 CEDAR STREET • NEW YORK 6, N.Y.

Branch Offices in Principal Cities of United States and Latin America



Abrasive Cut-Off Saw

912

Wallace Supplies Manufacturing Company, Chicago, Ill., has announced a new, versatile and low-cost abrasive cut-off saw. According to the manufacturer, the new unit permits fast, square and practically burr free cuts of tubular sections up to 4½″ OD or equivalent relieved shapes—solids up to 3″ diameter.

Operation of the Wallace high speed cut-off machine is safe, simple and fool-proof. Abrasive wheel mounted on ball bearing spindle maintains perfect alignment—cuts straight through work held on both sides of the wheel path for positive clamping—effectively reducing the chief cause of wheel breakage. Powered by 7½ hp. motor, with interchangeable vee belt pulleys to drive the 16″ cutting wheel at the proper speed for abrasive wheel or metal blade cutting. Wheel is quickly changeable in its swinging type guard.

TYLOX RUBBER PIPE JOINTS

Put BOULDER, COLORADO'S* new Irrigation Siphon ahead on 3 Major Counts . . .

★ MORE PIPE LAID PER DAY
★ COMPRESSION-TIGHT JOINTS
★ NO DETERIORATION

Making Joints with
TYLOX RUBBER GASKETS
is as simple as A B C

Cement tongue and snap on TYLOX Gasket. | Lubricate sliding surfaces with TYLOX Cement. | Shove the pipe home to line and grade.

Here's How—

Regardless of pipe size, Tylox Gaskets make it possible to lay pipe faster. Further, they eliminate costly delays as well. For instance, wet trenches can't slow up the work, and laid line may be backfilled immediately.

Rubber Tylox seals by *compression,* not adhesion. Its natural flexibility compensates for angularities in the line, or for soil stresses and surface loads. It stays tight, reducing maintenance by preventing ground water, sediment or roots from entering the line.

Sewerage and industrial waste acids have no effect on Tylox Joints. They are made of specially compounded rubber which is not subject to corrosion. Under ground, and under compression, Tylox Joints outlast the pipe itself.

Send for complete details and more case histories on TYLOX, the one pipe joint that meets the requirements of engineers, sanitary officials and construction men alike. Read the facts—and take advantage of TYLOX RUBBER JOINTS on your next concrete or vitrified clay pipe job.

* **PROJECT**—Ninth Avenue Irrigation Siphon, Farmer's Ditch Company, Boulder, Colorado.

PIPE—48" reinforced concrete, manufactured by Western Concrete Pipe Company, Denver, Colorado.

ENGINEERS—Engineers of Soil Conservation Service, Boulder, Colorado.

CONTRACTOR—Hudson Construction Company, Boulder, Colorado.

FEATURE—Inverted Siphon, Maximum head, 44 ft.

1830

HAMILTON KENT MANUFACTURING COMPANY
KENT, OHIO
427 West Grant St. ORchard 3-9555

Hydraulic Development Appoints Guthrie

Hydraulic Development Corporation, New York, N.Y., has announced the appointment of Mr. J. T. (Tom) Guthrie of Signal Mountain, Tennessee, as representative for the Kentucky and Tennessee area. He will carry a stock of Hydro-Tite and Fibrex in Nashville.

Mr. Guthrie also represents Hersey Manufacturing Company, A. P. Smith Manufacturing Company, Simplex Valve & Meter Company, and the National Water Main Cleaning Company.

Chicago Bridge Announces Three Sales Appointments And McDonald's Retirement

The Chicago Bridge & Iron Company, Chicago, Ill., has announced the appointment of Fred L. Goldsby as General Sales Manager, George S. Trees as Assistant General Sales Manager and Robert P. Davies as Export Manager. Mr. Goldsby and Mr. Trees will be located in Chicago and Mr. Davies in New York.

Mr. Goldsby started with Chicago Bridge & Iron Company in 1927, and has been Export Manager of the Company in New York since Jan. 1st, 1952.

Mr. Trees started with the Company in 1939, and has been Assistant to the Chairman of the Board since Jan. 2nd, 1953.

Mr. Davies has worked for Chicago Bridge & Iron Company since 1940, and has been manager of the Foreign Erection department in New York since 1947.

The Company also announced the retirement of Lewis McDonald, Vice President and Assistant to the Chairman of the Board. Mr. McDonald has worked for the Company over 44 years.

HYDRAULICALLY OPERATED VALVES

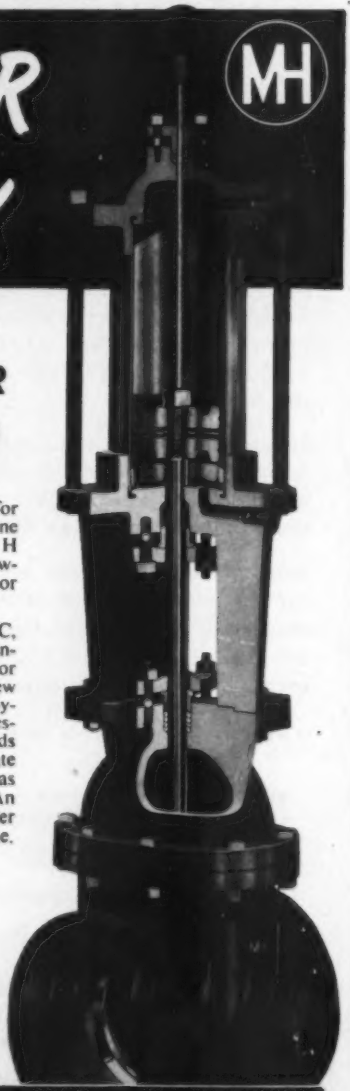
Put WATER To WORK

MH

SEAMLESS BRASS CYLINDER OR BRASS LINED

For frequent operation, remote control or for inaccessible valves, you may use your pipe line water pressure for opening and closing M & H hydraulically operated valves. If desired, however, cylinders operate equally well using oil or air pressure.

All M & H Gate Valves, Classes A, B and C, may be ordered equipped with hydraulic cylinders—brass tube cylinders as illustrated, or brass-lined cast iron cylinders. Outside screw and yoke can be installed to operate the hydraulic valve manually in event operating pressure fails. A bronze tail rod which extends through the top of the cylinder cover to indicate the position of the gates may also be used as a pull rod to operate the gate, if necessary. An adjustable stop may be installed on the cylinder cover to control the degree of opening of the gate.



The size of the cylinder depends on the size of the valve, water pressure available for hydraulic operation, and water pressure against the gates. For complete information, write or wire M & H VALVE AND FITTINGS COMPANY, Anniston, Alabama.

M&H PRODUCTS FOR WATER WORKS • FILTER PLANTS INDUSTRY • SEWAGE DISPOSAL AND FIRE PROTECTION

C. W. Krause

Neptune Sets Up New York Sales District And Moves to Larger Quarters

Neptune Meter Co., New York, N. Y., has announced the opening of a new sales district covering the states of New York and New Jersey. It was also announced that the sales headquarters and executive offices have been moved to larger quarters at 19 West 50th Street, New York 20, N. Y.

Named to head sales activities in the newly established district was Charles W. Krause as branch manager. He will be in charge of sales of water, petroleum and industrial meters in the two-state area.

Mr. Krause, a resident of Ridgewood, N. J., joined Neptune at its Long Island City factory in 1938 as a draftsman. During World War II, he served with the Army Engineer Corps. In 1946, he was sent to Boston as a sales engineer for the New England district where he remained until 1952 when he became assistant to Mr.

Walter H. Sieger, sales manager for petroleum and industrial meters.

A native of New York City, Mr. Krause attended Ridgewood, N. J., High School and Pratt Institute in Brooklyn. He is a member of the American Water Works Association and a former director of the Massachusetts Water Works Association.

New Bond-O Co.

Northrop & Company, Inc., Spring Valley, N. Y., has announced that in the future BOND-O will be manufactured and sold by THE BOND-O CO., Spring Valley, N. Y.

The new company is headed by Mr. James F. White who has a long association with BOND-O. Mr. Guy C. Northrop will remain with the new company as a consultant.

BOND-O will still be manufactured in the same plant by the same workmen from exactly the same minerals and under the same close supervision. This, the new company unconditionally guarantees.

A. T. Hunter

E. O. Pahmeyer

Combustion Engineering Elects Two Vice Presidents

Combustion Engineering, Inc., New York, N.Y., has announced that Arthur T. Hunter and Fred O. Pahmeyer have been elected vice presidents.

Mr. Hunter, a Cornell graduate in mechanical engineering, joined the company in 1941 as a member of the Philadelphia office sales staff. Since 1949 he has been at sales headquarters in New York in an executive capacity.

Mr. Pahmeyer has been general manager of the company's St. Louis manufacturing division since 1927, when the Heine Boiler Co. was acquired by Combustion Engineering. He originally joined Heine in 1905 following graduation as a mechanical engineer from the University of Illinois. As vice president he will continue as manager of the St. Louis division.

FOR ACCURATE REMOTE MEASUREMENT

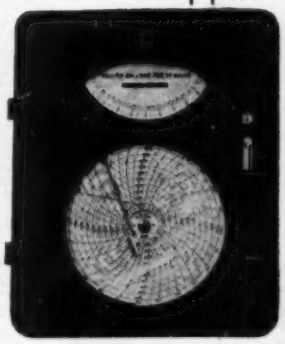
of Flow, Liquid Level, Pressure

NEW! SIMPLEX ORTHOFLOW®

● Now you can transmit data accurately over great distances for instant reference at central or control points.

TRANSMITTER – Compact new electric unit actuates both in-plant and remote meters . . . unaffected by normal variations in voltage, temperature. Simple, dependable, rugged. Accuracy of ±2% at any point over wide flow ranges.

RECEIVER – Time-proven Simplex H Meter. Precisely duplicates transmitted data . . . automatically resets to correct data after power interruptions. Indicates, records, totalizes. Easy-to-read flow scale and chart.



SIMPLEX VALVE & METER COMPANY
6743 Upland St., Philadelphia 42, Pa.

Write for Brochure

SIMPLEX®
VALVE AND METER COMPANY

Dresser Appoints Monroe Ass't To Sales Manager

Dresser Manufacturing Division, Bradford, Pa., has announced the appointment of William L. Monroe as Assistant to the Sales Manager.

In his newly created position, Monroe will coordinate relations between Dresser's expanding customer service department and its customers in the distributor, gas, water, oil, plumbing and industrial markets.

Previously manager of the distributor section of customer service, Monroe joined Dresser in 1947 after serving in Europe during World War II. As a reserve officer, he was recalled during the Korean War. Monroe attended the University of Michigan.

Personnel Changes at Atlas Mineral

Atlas Mineral Products Company, Mertztown, Pa., has announced the following personnel changes as part of its program for expansion:

Kenneth T. Snyder, who joined the firm in 1948, has been appointed Western Regional Sales Manager.

Eugene Kirkpatrick, formerly Eastern Divisional Sales Manager for Farr Company, has been appointed Eastern Regional Sales Manager.

Walter Pascoe, who joined the firm as a research chemist in 1949, has been appointed Assistant Research Laboratory Director.

Amercoat Opens New Executive Offices and Laboratory

Amercoat Corporation, South Gate, Calif., is now occupying new executive offices and a new research laboratory recently erected at its home office site at 4809 Firestone Boulevard, South Gate, California.

The new buildings have more than doubled the size of Amercoat's research and laboratory facilities. In addition to the laboratory wing, another wing provides new executive offices adjoining the existing facilities which were also remodeled.

Completion of the new South Gate quarters marks the third major expansion for Amercoat within the past year. Last June, the company moved its South Central District office from Dallas to Houston, Texas, where new offices and a warehouse were erected.

B. M. Prestholt

R. F. Coltart

Link-Belt Appoints Two Sales Managers For Pacific Divisions

Link-Belt Company, Chicago, Ill., has announced the appointment of two new West Coast sales managers. Rodney F. Coltart is the new sales manager of the Central Pacific Division, with headquarters at the company's San Francisco plant, and Benjamin M. Prestholt is the new sales manager of the Southern Pacific Division, with headquarters at the Los Angeles plant.

(Continued on page 116A)

When pipe efficiency drops you need... **National**

When pumping costs rise, pressures fall and capacity is way down—
You need *National* cleaning!

Often, lines assumed to be in top operating condition are actually delivering less than half of their rated capacity. For instance—a tuberculated 48" pipe, having a co-efficient of 93 can carry no more water than a clean 42" pipe. Think how much difference this makes in costs when it must be compensated for by either greater power consumption at the pumping station or by larger mains in the ground.

Remember, the National Water Main Cleaning Company *guarantees* to restore any water main to 95% of its original carrying capacity.

There's no obligation when National's engineers inspect and estimate cleaning costs of your mains, so write or phone today!

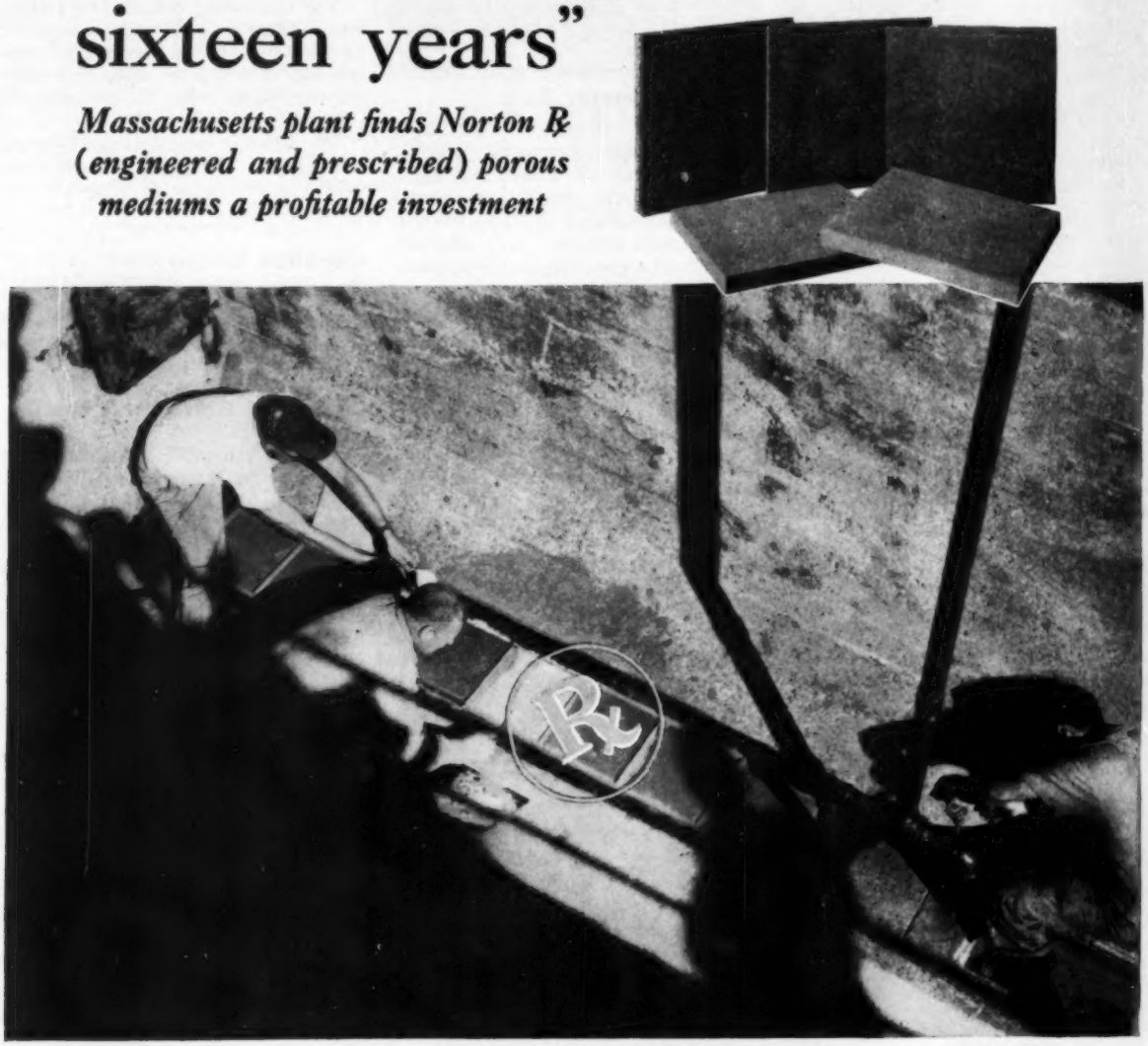
NATIONAL WATER MAIN CLEANING COMPANY
50 Church Street • New York, N. Y.

37

ATLANTA, 333 Candler Building • BOSTON, 115 Peterboro Street • DECATUR, P.O. Box 385 ERIE, PA., 439 East 6th Street • FLANDREAU, S. D., 315 N. Crescent Street • KANSAS CITY, MO., 2201 Grand Avenue, 406 Merchandise Mart • LITTLE FALLS, N. J., P.O. Box 91 • LOS ANGELES, 5075 Santa Fe Avenue • MINNEAPOLIS, 200 Lumber Exchange Building • RICHMOND, VA., 210 E. Franklin Street • SALT LAKE CITY, 149-151 West 2nd So. Street • SAN FRANCISCO, 681 Market Street • SIGNAL MOUNTAIN, TENN., 204 Slayton Street • HAVANA, P.O. Box 531 • MANITOBA, CANADA, 576 Wall Street • MONTREAL, 2032 Union Avenue • SAN JUAN, PUERTO RICO, Apartado 2184

"Our Norton plates lasted sixteen years"

Massachusetts plant finds Norton Rx (engineered and prescribed) porous mediums a profitable investment



Ready For Many More Years Of Trouble-Free Service. Norton ALUNDUM* plates are replaced with new ones after 16 years of service in the Leominster, Mass., sewage disposal plant. Norton engineered and prescribed porous mediums supply money-saving Rx's for many important applications.

Selecting replacements for plates was no problem at this sewage plant. Like so many other users of Norton plates, they had ample proof — 16 years of it, in fact — of the outstanding efficiency and service life engineered into all Norton porous mediums.

Patented *controlled structure* processing of Norton ALUNDUM porous mediums assures even distribution of pores in sizes and open-pore ratios that make them the ideal Rx's for uniform diffusion. And Norton tubes bring you this uniform diffusion over their entire area, thanks to their seamless construction that also makes them much easier to clean.

Many Other Advantages

of Norton Rx porous mediums include exceptional resistance to breakage, chipping and to cleaning acids. You can get them in a wide range of sizes . . . tubes and discs for aeration in activated sludge treatment . . . tubes for diatomite filters in swimming pools . . . plates for rapid sand filters in water filtration.

Norton Can Supply You

with illustrated booklets, charts, tables and other helpful information on all porous medium applications. Ask your Norton Representative, or write to NORTON COMPANY, 228 New Bond St., Worcester 6, Massachusetts.

NORTON

POROUS MEDIUMS

Engineered... Rx... Prescribed

Making better products... to make other products better

*Trade-Mark Reg. U. S. Pat. Off. and Foreign Countries

(*Continued from page* 114A)

Mr. Coltart, recently a sales engineer at Link-Belt's Colmar, Pa., plant, started with the company in 1935. He served in the engineering department of the Philadelphia plant, spending much time on research and development work, and in engineering sales at Philadelphia before going to Colmar. During World War II, Mr. Coltart was a captain in the U. S. Army Sanitary Corps.

Mr. Prestholt started his career with Link-Belt in 1936 in the engineering department of the company's Caldwell plant in Chicago. After serving six years during World War II as a lieutenant colonel, U. S. Army, Mr. Prestholt returned to the Caldwell plant engineering department as a specialist for bulk materials handling equipment. Later he was appointed sales engineer.

Hagan Promotes Boho

Hagan Corporation, Pittsburgh, Pa., has announced that M. J. Boho, vice president in charge of sales, has been named general manager of the corporation and of all its subsidiaries. These include Hall Laboratories, Inc., Calgon, Inc. and The Buromin Company.

Mr. Boho was elected vice president and general manager at a May 22 special meeting of the Hagan directors.

Mr. Boho was graduated by Lafayette College in 1930 with a bachelor of science degree in mechanical engineering. He was in sales and engineering posts until 1936, when he joined Hagan Corp.

Mr. Boho became assistant general manager of sales in 1942 and vice president in charge of Hagan Corp. sales in 1948.

Conoflow Corporation Announces New Department

Conoflow Corporation, Philadelphia, Pa., has announced the formation of a new Department to handle specialized engineering problems in the sale and application of Conoflow equipment.

E. K. Graham, Jr., former Chief Engineer, has been named Manager of Technical Services and will head the new Department which was created primarily to handle the application of Conoflow Rotomotors and Cylinder Conomotors which are used extensively as original equipment on Catalyst valves, large gate valves, variable speed drives, pumps, etc.

Mr. Graham has been with Conoflow for more than ten years and is well known in the field of automatic control. He is a graduate of Drexel Institute of Technology and a member of the Instrument Society of America.

Executive Appointments at De Laval

De Laval Steam Turbine Company, Trenton, N. J., has announced the appointment of H. G. Bauer to the new post of Vice President and General Sales Manager. In his new duties, Mr. Bauer will assume supervision of all company sales activities. Bauer's previous duties were those of Vice President in charge of Engineering and Manager of the Marine Division.

Mr. W. A. Neumann has resigned as Vice President in charge of sales at De Laval Steam Turbine Company to assume new duties as Executive Vice President and Treasurer of the De Laval Separator Company, Poughkeepsie, N. Y.

Mr. Bauer joined De Laval in 1937 after extensive marine engineering and shipbuilding experience in Europe and in this country. He received his technical education in Europe and is a graduate of Technische Hochschule, Hannover, Germany. Mr. Bauer has been associated with the Marine Division since he joined the Company and was appointed Manager of the Marine Division in 1946. In 1948 he was appointed Executive Engineer and in

Pipe Line Equipment
WATER • GAS • SEWER

Bottled Gas Lead Melting Furnace

Calking Tool Outfit

For water mains up to 12". Strong leather bag. Keeps the right tool for every job within easy reach.

Portable Lead Melting Furnace

A handy outfit for quick action, equipped with gasoline burner.

Asbestos Joint Runners

Best quality asbestos rope, brass caps attached to each end. Equipped with clamps.

Test Plugs for Bell or Spigot End Cast Iron Pipe.

Pipe Cutter

Inexpensive way of cutting pipe. Every wheel in contact with the pipe is a cutting disc, so cutter need be moved only a short distance to cut entirely around the pipe.

M-D Cut-In Connections for Sewers

A light cast iron fitting with bell end for connecting house service with main sewer pipe without necessity for placing a Y-branch or T-branch in the sewer line.

Tapax

The original manhole cushion. Takes the bang out of manhole covers.

M-Scope Pipe Finder

It's easy to locate a buried pipe line with this handy pipe finder.

Leak Detector

A truly fine instrument designed to solve even the most difficult leak detecting problem.

On this page are shown only a few of the hundreds of items to be found in the POLLARD Catalog. Write for a copy of Catalog No. 25G.

JOSEPH G. POLLARD CO., INC.

Western Office
1064 Peoples Gas Bldg.
Chicago, Ill.

MAIN OFFICE AND FACTORY
New Hyde Park, N. Y.

Southern Office
333 Chandler Bldg.
Atlanta, Ga.

1949 elected Vice President of Engineering and continued in the capacity of Manager of the Marine Division.

W. A. Neumann, Jr. has served as Vice President in Charge of Industrial Sales since 1951. He joined the Company in 1946 and has previously served as Controller and Assistant Treasurer. Before becoming Vice President, Mr. Neumann was Manager of the Standard Products Division and was responsible for the Engineering and Sales of the Company's line of power transmission equipment and rotary pumps.

Riker Appointed Ass't To President of Combustion Engineering

Combustion Engineering, Inc., New York, N. Y., has announced the appointment of Robert L. Riker as assistant to the president. Mr. Riker, a graduate of Rutgers University, joined the Company in 1937 and has served as assistant to the general sales manager, manager of the Proposition Department and assistant general sales manager. Since the retirement of A. C. Weigel, vice president, in 1953, Mr. Riker has carried on certain of Mr. Weigel's responsibilities, including supervision of the Proposition Department. In his new position he will continue these responsibilities, as well as being available for special assignments by the president.

Coppage Joins Permutit

The Permutit Company, New York, N. Y., has announced that Mr. John S. Coppage has joined its Sales Department as Manager of Sales, Chemical Service Division.

Mr. Coppage will be responsible for directing field salesmen and engineers

in the application and sale of Chemical Division products and services, under the direction of E. M. Partridge, Manager. His efforts will be devoted toward extending the service facilities in the fields of boiler feed, air conditioning, and corrosion control.

Well equipped for his assignment, Mr. Coppage is a graduate of the University of Minnesota, with a degree in Chemical Engineering. For ten years, he was sales and service engi-

(*Continued on page* 118A)

Sparling WATER CONTROL EQUIPMENT

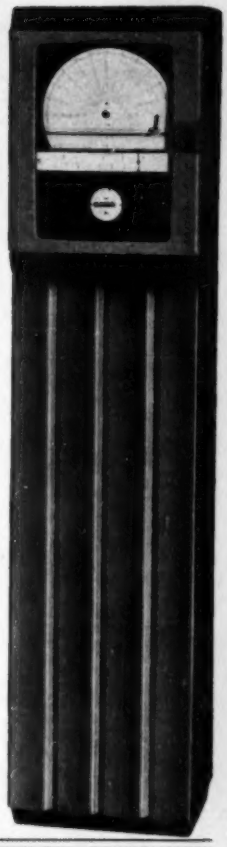
INFORMATION AT YOUR FINGER TIPS

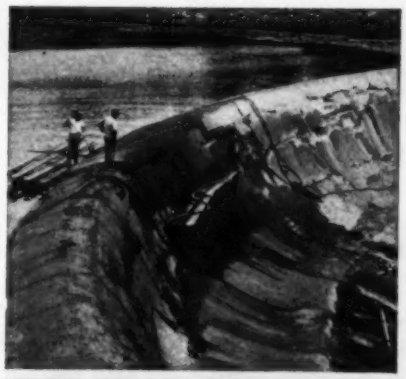
WHAT you need to know, WHERE you need to know it, with a Sparling Recorder like this! It is the companion to the Sparling Meter on the Main Line and tells instantly, though miles away, what has passed through that main line, shows present rate of flow, and produces clear record of rates of flow—7-day or 24-hour. Other models for up to 60 days!

Bulletin 313 and quotations are yours for the asking.

SPARLING METER COMPANY INCORPORATED

PITTSBURGH 13.....3530 Forbes St.
LOS ANGELES 54.....Box 3277
CHICAGO 8.....1500 S. Western Ave.
CINCINNATI 2.....626 Broadway
NEW YORK 17.....101 Park Avenue
BOSTON 8.....6 Beacon Street
SEATTLE 1.....1932 First Avenue
DALLAS 1.....726 Reserve Loan Life Bldg.
KANSAS CITY 6, MO.....6 East 11th St.
ATLANTA 3.....66 Luckie St. N.W.
SAN FRANCISCO 24.....85 Industrial St.





DAM REPAIRED WITH "GUNITE"

The two photographs show the Bulls Bridge Dam of the Connecticut Light and Power Company, which is one of many dams we have repaired for this company.

The upper view shows the work in progress, and gives some idea of the condition of this structure before repairs were made. The lower view is of the completed job.

After chipping out the loose and disintegrated concrete and sandblasting the entire area, heavy reinforcing mesh was placed over the surface of the old concrete and "GUNITE" applied two inches thick, plus the material required for filling deeply eroded portions.

Our 72-page bulletin C-2400 describes scores of similar "Gunite" jobs.

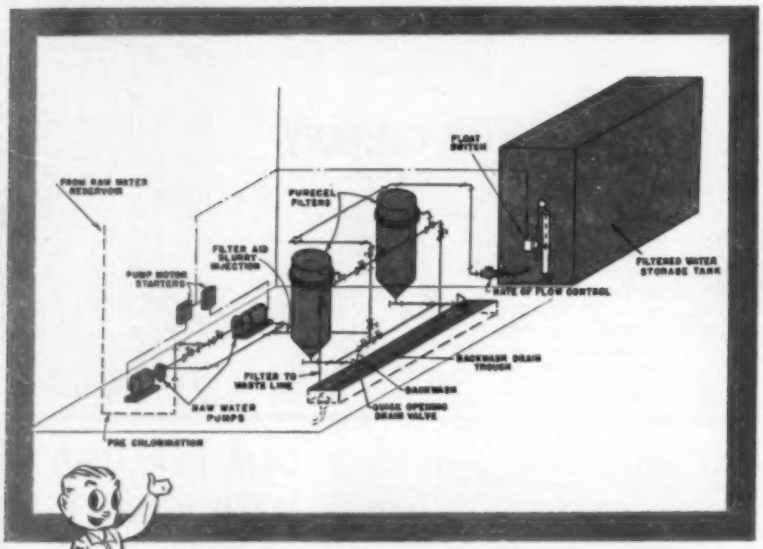
Write today for bulletin A-2400

CEMENT GUN COMPANY
"GUNITE" CONTRACTORS
GENERAL OFFICES – ALLENTOWN, PA., U. S. A.
MANUFACTURERS OF THE CEMENT GUN

(*Continued from page* 117A)
neer for The Flox Company, distributors of Nalco chemicals and for five years was Sales and Merchandise Manager of a division of the Minnesota Mining and Manufacturing Company.

C. G. Hart Joins Smith-Blair

Smith-Blair Company, South San Francisco, Calif., has announced that Charles G. Hart of Portland, Oregon, has joined the Company as a Sales Engineer. Mr. Hart was formerly associated with the H. D. Fowler Co., an Industrial Waterworks and Sanitary Engineering firm whose main office was at Seattle, Washington. Chuck, as he prefers to be known, attended the University of Michigan State, and Pratt Institute, New York City, N.Y. Transplanted during the war years by the Army from Detroit, Michigan, to the West Coast, Chuck saw service as a Gun Crew Commander aboard Transport Ships, and concluded his Army career as a Troop Commander of a Mechanized Cavalry Reconnaisance Squadron. During his association in the Pacific Northwest he was active as a part of the membership committee of the American Waterworks Association. Mr. Hart will work out of the Smith-Blair South Gate Branch.



Have You Considered Purecel Filtration for Potable Water Supplies?

When properly engineered and applied, a Purecel Diatomaceous Earth Filtration Plant can save a large percentage of the cost of a conventional sand filter plant, and can provide important operational economies as well. Several full-scale installations have already been made with very gratifying results.

We will be glad to give you the benefit of our experience with this new type of water filtration system. Write us for data and recommendations on a pilot installation for your water supply . . . also ask for Bulletins 1800-S and 1800-1 (reprints of recent technical articles on diatomite filtration case histories). Proportioneers, Inc., 350 Harris Ave., Providence 1, R. I. Technical service representatives in principal cities of the United States, Canada, Mexico, and foreign countries.

PROPORTIONEERS
DIVISION OF B-I-F INDUSTRIES, INC.
BUILDERS IRON FOUNDRY • OMEGA MACHINE CO. • BUILDERS-PROVIDENCE, INC.
BIF METERS FEEDERS CONTROLS

Bailey's Seattle District Office Moves

The Seattle District Office of Bailey Meter Company, Cleveland, Ohio, has moved to larger quarters. The new address is: Bailey Meter Company, 200 Broadway, Seattle 22, Washington.

Under the managership of K. E. Atwood, the Seattle District is staffed by Instrument Engineers A. H. Johnson, R. M. McGuire, F. M. Mehle, and Resident Engineer C. G. Barnhart in Portland, Ore. These engineers are specialists in flow measurement, combustion and automatic control applications.

The Seattle District, serving power and process industries, is comprised of 850,000 sq. miles and includes the states of Washington, Oregon, western Idaho, western Montana and all of Alaska.

Foxboro Names Frymoyer Vice President

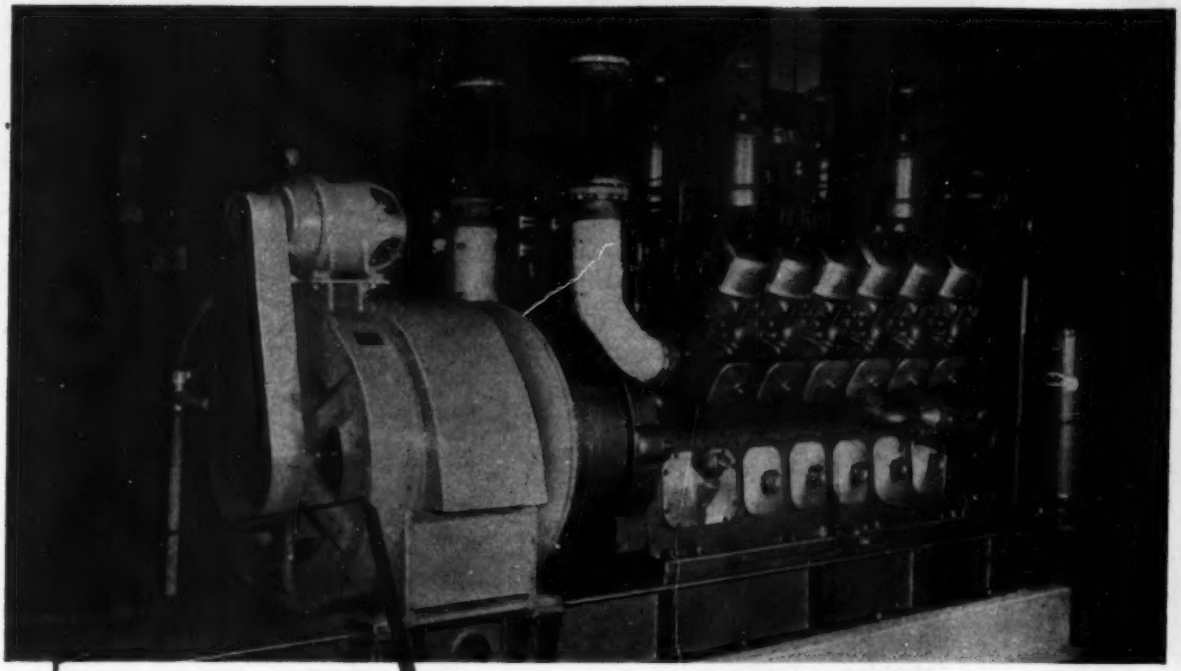
The Foxboro Company, Foxboro, Mass., has announced that Mr. W. W. Frymoyer has been elected a vice president of the Company.

Joining the firm in 1926, Mr. Frymoyer served as Director of Research and in 1939, was appointed General Superintendent. Since 1951 he has been Factory Manager and will continue in this capacity, supervising all instrument manufacturing activities of the company.

He was formerly connected with the National Bureau of Standards, Washington, D.C., and received his degree in mechanical engineering at Massachusetts Institute of Technology.

Water Seals, Inc., Promotes Fucik

Water Seals, Inc., Chicago, Ill., manufacturers of Labyrinth Waterstop, has announced the election of Frank M. Fucik as President of the company. Mr. Fucik served the company since its inception as Vice President. Also elected were Arthur Hoffman, Vice President while E. W. Hillier continues as Secretary-Treasurer of the company.



Power for Prentiss, Miss. less than 5 mills per KWH!

. . . and LE ROI L3460 ENGINE saves enough on operating costs to pay for itself in about 3½ years

MUNICIPAL power requirements — for pumping, for generating electricity, for standby service — cost less with Le Roi engines. The Le Roi installation at Prentiss, Mississippi is a good example:

In order to meet the demands of an increasing electric load, Prentiss has supplemented its old diesel-powered generating plant with a Le Roi L3460. Burning natural gas, this Le Roi produces power for less than $0.005 per KWH — about one-half the cost with diesel power.

The Le Roi engine runs continuously in 600-700-hour periods between oil changes. Savings on fuel and lubricating oil amount to around $550 per month, allowing the Le Roi to pay for itself in about 3½ years.

Use dependable, low-cost Le Roi power to help ease the tax load in *your* community. Le Roi engines are available in sizes from 20 to 600 hp — custom generator sets in sizes from 50 to 300 KW. They operate on no-cost sewage gas, natural gas, butane, or gasoline.

E-69

Write today for detailed information

LE ROI

LE ROI COMPANY

Plants: MILWAUKEE CLEVELAND GREENWICH, OHIO

• If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.

Dall Flow Tube Bulletin

913

Builders-Providence, Inc., Providence, R. I., has issued a 16-page engineering bulletin on the new **Dall Flow Tube.** The Technical Bulletin describes the new short differential producing metering device which has the lowest permanent loss of head of any known velocity-increasing differential producer.

The bulletin includes information on: Recovery characteristics, accuracy, applications, range, flow formula, laying length, and working pressure of the device. Also included are sections on: Installation, power consumption, effect of approach and downstream piping and fittings, and location of instruments. Tables and graphs are included in the bulletin to aid in the selection of the proper Dall Flow Tube and its accompanying secondary instruments.

it's tomorrow's pipe cutter today *for* water *and* gas works

Fein PORTABLE AUTOMATIC PIPE SAW

Pneumatic or Electric Drive

- Weight: only 145 lbs. plus **single** chain link.
- Clearance: 12" maximum around pipe.
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Valves and Accessories

914

The Rensselaer Valve Co., Troy, N. Y., has published a 12-page bulletin in color with 38 illustrations of the most recent developments in gate valves, square bottom valves, check and air release valves and hydrants. Accessories including gearing combinations, by-passes, and electric, air and cylinder operation are included. "O" Ring Seals, Ring Tite and Mechanical Joints as applied to valves and hydrants are also illustrated and described.

Water Purification by Ozone

915

General Ozone Corp., Chicago, Ill., has published a new 4-page bulletin that describes the advantage of the **Ozone Method of Water Purification** and illustrates a typical installation.

The bulletin discusses how electrically generated ozone is intimately mixed with the raw water and held in contact for a predetermined period of time, thus effectively destroying pathogenic organisms and many inorganic impurities as well. The aeration accomplished in the mixing process improves the odor and taste of the water. The result is safe, sterile water suitable for use even in food or beverage industries where delicate flavors and aromas are of paramount importance. Standard unit installations are available to 10,000 g.p.h. capacity. Larger units are designed to specifications.

Instrumentation and Control For Water Filtration Plants

916

Builders-Providence, Inc., Division of B-I-F Industries, Inc., Providence, R. I., has just issued a bulletin on **"Instrumentation and Control for Water Filtration Plants."**

This sixteen page bulletin describes the complete line of equipment for water treatment plants and includes many sketches of typical instruments of flow meters, gauges and rate of flow controllers.

Indicator-Recorder

917

Omega Machine Co., Division of B-I-F Industries, Inc., Providence, R. I., has just issued a bulletin on the Omega Machine Co. **Loss-In-Weight Indicator-Recorder** for use with the volumetric dry feeders.

This bulletin includes a description of the use and operation of this Loss-In-Weight Indicator-Recorder. Photographs and line drawings are also included.

Treatment of Trade Wastes

918

The Finishing Lime Association of Ohio, Toledo, Ohio, has just released Bulletin No. 2, on **Treatment of Trade Wastes with Dolomitic Lime.**

The bulletin, in case history style, gives the location, problems, and solutions from four different waste treatment plants. Photographs, and a flow sheet along with descriptive text are given for each installation. A short discourse on the Dolomitic Lime Industry completes the bulletin.

Acid-Proof Cement

919

The Robinson Clay Product Co., Akron, Ohio, has just released a new, revised bulletin containing a full description of the product and instructions for application of **Staminite Acid-Proof Cement.**

Attractively illustrated and printed in two colors, this four-page bulletin gives detailed information on mixing, as well as all other necessary application data. According to the bulletin Staminite is a chemically setting cement and does not depend upon acid washes to become acid proof. Nor does Staminite cement depend on air to become hard. When it sets chemically it becomes acid proof and water-proof. It is an ideal acid-proof cement when used as jointing material in acid resistant ceramic products construction, such as acid proof brick, tile and vitrified pipe lines.

Diatomite Filters For Swimming Pools

920

Graver Water Conditioning Co., New York, N.Y., has just published a bulletin on **Graver Diatomite Filters.**

Text, photographs, and schematic diagrams showing typical arrangements of the diatomite filters explain how the liquid to be treated is passed through a filtering medium consisting of a form of silica known as diatomaceous earth.

The bulletin notes the 50% to 70% space savings virtue of the diatomite filter over sand or anthrafilt filters of the same capacity, leading to lower building and installation costs. Besides yielding water free of all turbidity and all known micro-organisms, the filters save up to 50% in wash water over sand or anthrafilt filters, according to the bulletin.

Centrifugal Pump Fundamentals

921

Ingersoll-Rand, New York, N.Y., has available for distribution an interesting and instructive booklet on **"Centrifugal Pump Fundamentals."**

This 12-page form is written in simple language and illustrated with easily understood diagrams. It should be useful to all pump operators and installation and mainte-

(*Continued on page* 122A)

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AMERICA'S LARGEST LINE OF PIPE CLEANING TOOLS AND EQUIPMENT

(*Continued from page* 121A)

nance men as it explains the principles of operation, defines the various terms used in pump calculations and works out typical pump problems.

Included in the booklet are "Centrifugal Pump Analogies," "How to Calculate," "Total Head or Pressure," "Capacity or Quantity Delivered," "Specific Gravity or Weight of Liquid," "Hydraulic and Brake Horse Power," and "Pump Pressure."

All of the individual items are made clear by simple illustrations and comparisons or, where necessary, by typical problems and curves.

Continuous Turbidity Measurements

922

Minneapolis-Honeywell Regulator Co., Industrial Division, Philadelphia, Pa., has revised its **Instrumentation Data Sheet** on continuous indication and recording of turbidity measurements. The new data sheet describes the applications of ElectroniK potentiometers with the new turbidimeter developed and sold by General Electric Company's Special Products Section, Schenectady, New York.

Of value to any process where suspended solids content of a liquid must be altered, the G. E. Turbidimeter and ElectroniK potentiometer are an industrial instrument combination designed for precise and long service applications in food, chemical and metalurgical industries, sewage and water treatment plants, and stream monitoring surveys. Copies of the revised data sheet should be in the file of every engineer concerned with the tedium, inaccuracies and long man-hour requirements of ordinary turbidity measuring methods.

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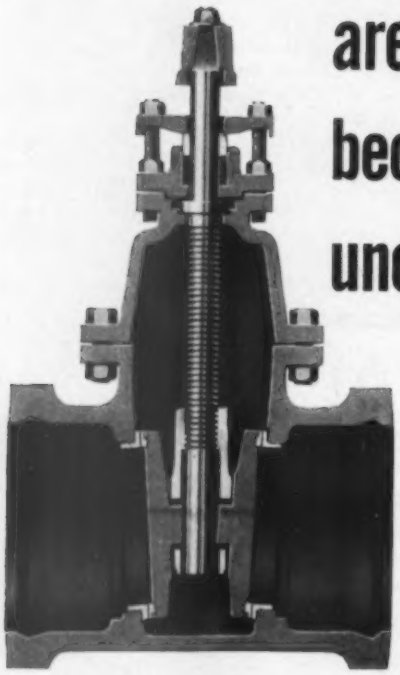

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Controls for Liquids and Gases

923

Simplex Valve & Meter Company, Philadelphia, Penna., has just issued a greatly revised edition of the handy Simplex general catalog of **Measuring and Control Equipment.** This practical booklet supersedes an earlier volume produced in 1950. Brought up-to-date and completely revised, it presents a compilation of 36 information-packed pages, all valuable to operating and supervisory plant personnel.

The bulletin lists all Simplex equipment for the measurement and control of liquids and gases. Illustrated are many types of controllers, gauges, manometers, recorders, meters, valves, Venturi tubes, etc., all applicable for water and sewage works, power and processing industries.

Pipeline Progress

924

C. N. Flagg & Company, Inc., Meridien, Conn., has just published a new, colorfully illustrated brochure, **Pipeline Progress,** that describes forty-five years of pipeline installation work.

The brochure contains photographs showing actual pipeline installations for many and varied projects in all parts of the country. The text tells how the C. N. Flagg Company, from a small beginning in 1905 in the residential plumbing field, has now progressed to the point where they employ 200 people and are exclusively engaged in laying pipelines for municipalities, utilities, industrial organizations, large institutions, state-wide natural gas projects and complete petroleum installations.

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Metering and Proportioning Pumps

925

Hills-McCanna Company, Chicago, Ill., has just issued a new bulletin which describes their line of **"K" Type Metering and Proportioning Pumps.**

The bulletin explains the operation of the pump, illustrates its design features and gives complete capacity and pressure information on the entire line. The "K" Type Pump is a completely enclosed in-line, direct acting, hydraulic drive pump with built in pressure relief valves and adjustment while in operation.

Centrifugal Pumps

926

De Laval Steam Turbine Company, Trenton, N.J., has just issued a four-page illustrated bulletin containing design features and specification data on the **De Laval type GS** (General Service) **Pump.**

The new bulletin illustrates the ease of maintenance and service features of the De Laval GS pumps, including the rotor assembly which contains all working parts and which lifts out of the casing as a single unit. Other features are the mechanical seal and life-time lubricated bearings.

The bulletin presents a full-page cut-away diagram of the GS pump. Specification data describes in detail the design and construction of all major parts.

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Send -- today -- for our Job Cost Estimate form. We'll be glad to provide our estimate for your particular job, and without cost or obligation.

Flexible has specialized equipment and crews for sterilizing water mains — Write for full details!

Service Manual on Pipe Leaks

927

The M. B. Skinner Company, South Bend, Indiana, has just published a new catalog and manual, showing **Clamps and Saddles For Steel or Cast Iron Pipe.** It contains large color illustrations and cross section detail drawings of the company's line of pipe repair clamps, service fittings and drilling equipment, plus complete descriptions and specifications.

Several completely new products are shown for the first time. Two of these, the Coupling Saddle and the Wall Service Fitting, are particularly interesting to gas and water men.

A series of installation pictures and captions for each clamp provide clear and concise, step by step, instructions for the repair of all types of pipe leaks.

Geared Motor Catalog

928

Belgian Electric Sales Corporation, New York, N.Y., exclusive sales and service organization for ACEC electric motors and SADI speed reducing equipment in the United States and Canada, has published a new **ACEC-SADI Geared Motor Catalog.**

The new catalog, covering the ACEC-SADI line of geared motors built to NEMA specifications, is a fourteen-page, technical brochure, including a complete price list, dimensions, operating characteristics and photographs and diagrams prepared by the Engineering Design Departments of Ateliers de Construction Electriques de Charleroi (ACEC) and Societe Auxiliaire d'Industrie (SADI).

Standby Electric Plants and Controls

929

D. W. Onan & Sons, Inc., Minneapolis, Minnesota, has issued a Technical Bulletin covering the installation of emergency standby **Electric Generating Plants and Automatic Line Transfer Controls.**

Intended "for the man who knows very little about the subject," the bulletin covers subjects of more or less technical nature in simple language. Descriptions of standby electric generating plants, methods of

control and easy-to-understand wiring diagrams are included in this 16-page, 8½" x 11" booklet.

Typical installations of both water-cooled and air-cooled Onan Standby Electric Plants are pictured clearly for easy understanding.

Waterstop Booklet

930

Sika Chemical Corp., Passaic, N. J., has just published a booklet on the **IGAS Joint Sealer.** The booklet describes the joint sealer as a waterstop which is installed after concrete is placed.

Based on test results and field performance on all types of structures over a 20-year period, the booklet discusses this non-meltable mastic material which can durably seal joints subject to severe movement and pressure, between a variety of rigid structural materials such as concrete to concrete, concrete to steel, even concrete to glass.

According to the booklet, Igas is described as non-sagging to 180° F., non-brittle below —10° F., resistant to water, weather and chemicals, with an ability to resist temperatures as high as 500° F. without becoming fluid, polymerizing, or otherwise breaking down.

Pocket Size Fahrenheit And Centigrade Chart

931

Moeller Instrument Company, Richmond Hill, N. Y., has available a handy pocket size chart of **Fahrenheit and Centigrade Temperature** equivalents.

The reverse side of the chart illustrates by means of an animated demonstration, the easy reading qualities of their thermometers made with Moeller glass red reading column.

The chart is 8½" x 3½" in size. It is easily carried in the pocket or wallet or may be placed under glass desk tops for easy reference.

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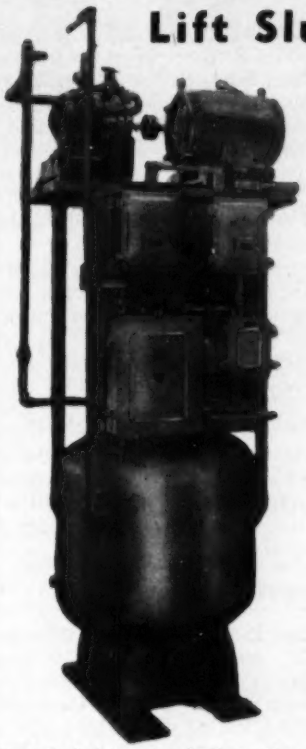

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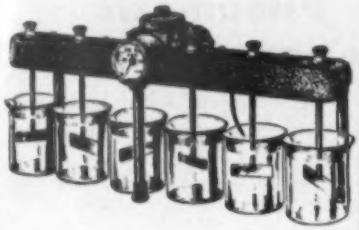

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Well Screens for Water Wells

932

Edward E. Johnson, Inc., has just issued its 50th Anniversary Catalog on **Well Screens For Water Wells.**

The catalog covers the function which well screens play in developing high-capacity, sand-free wells, and the different types of Johnson well screens which are available to meet any specification or method of installation.

Other important topics covered are the selection of the proper well-screen metal for different applications, screen installation and the development of water-bearing formations. Methods of gravel treating wells are discussed, and technical bulletins available for free distribution are listed. Well-illustrated and informative, this catalog is useful as a handbook to all who are interested in ground-water development.

Dorrco Densludge Process

933

The Dorr Company, Stamford, Conn., has announced the availability of a new six-page, two-color bulletin, **"The Dorrco Densludge Process,"** which describes the applications, operation and advantages of this new Process for the production of a thicker sewage sludge. Operating results from actual plant tests are included as well as flowsheets of three typical applications and a sectional elevation drawing of the specially designed Densludge Thickener.

According to the bulletin the Dorrco Densludge Process reduces sewage sludge volume 50% with a resulting increase in digester capacity. It is applicable to both primary and secondary sludge treatment and entails the continuous withdrawal of the dilute sludges involved and controlled thickening in the Dorr Densludge Thickener.

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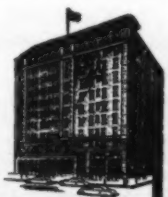

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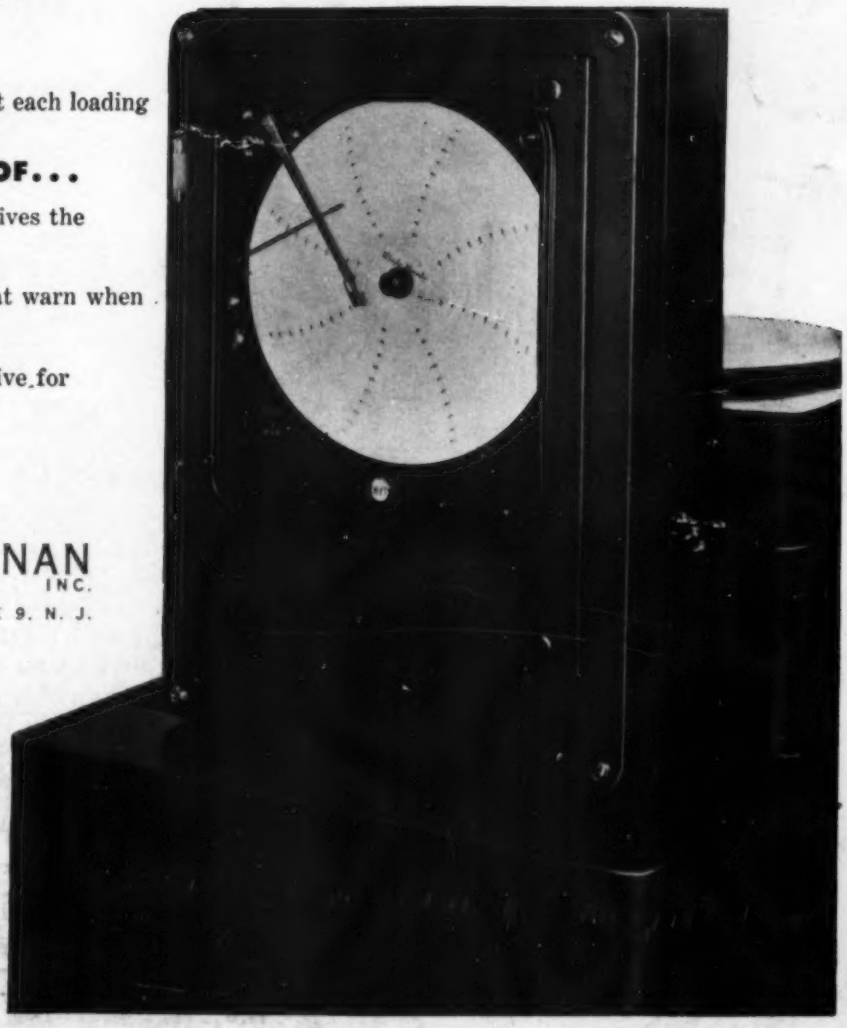

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